# THE JOURNAL OF GAS LIGHTING
## WATER SUPPLY & SANITARY IMPROVEMENT

VOL. LXXV. No. 1927.] LONDON, APRIL 17, 1900. [52ND YEAR. PRICE 6d.



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Yield of Gas per Ton . . 10,500 Cubic Feet.
Illuminating Power . . . 16·4 Candles.
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Rich in Illuminating Power and Yield of Gas.
Above the Average in Weight and Quality of Coke.
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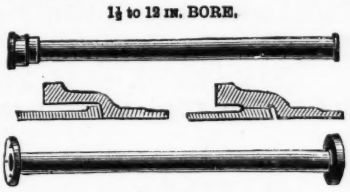
**GAS AND WATER PIPES**
1½ to 12 IN. BORE.



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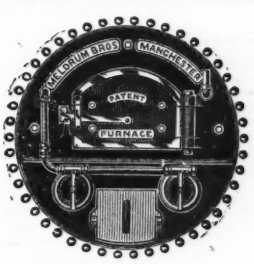


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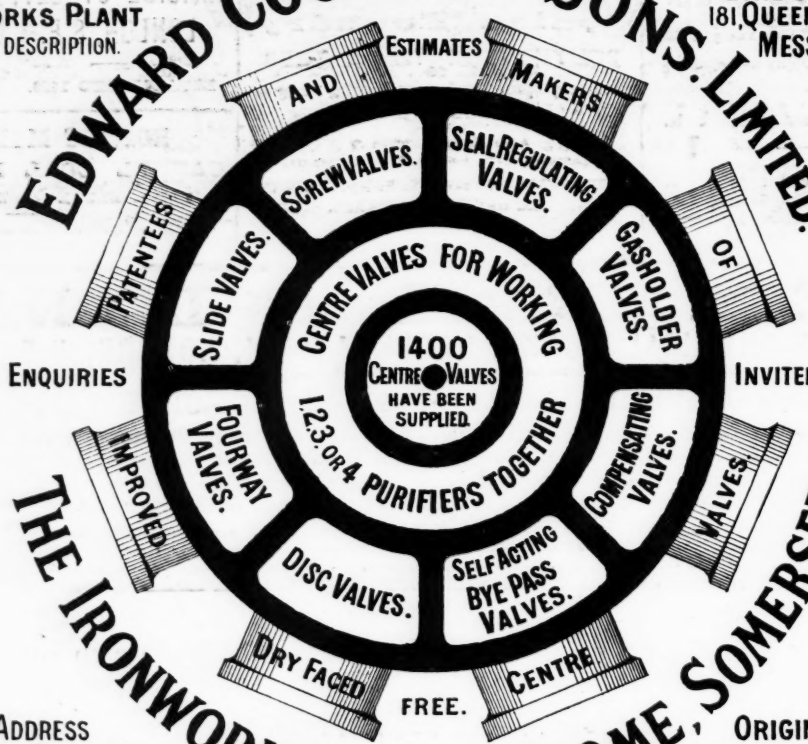


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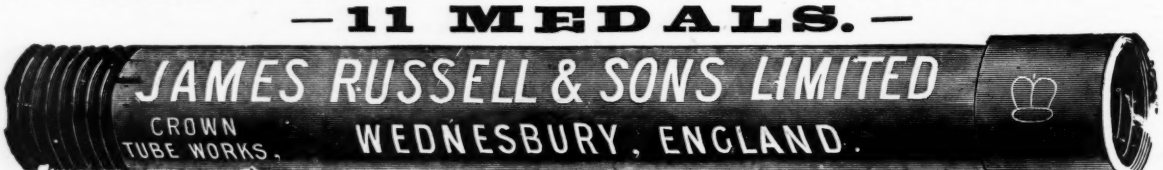


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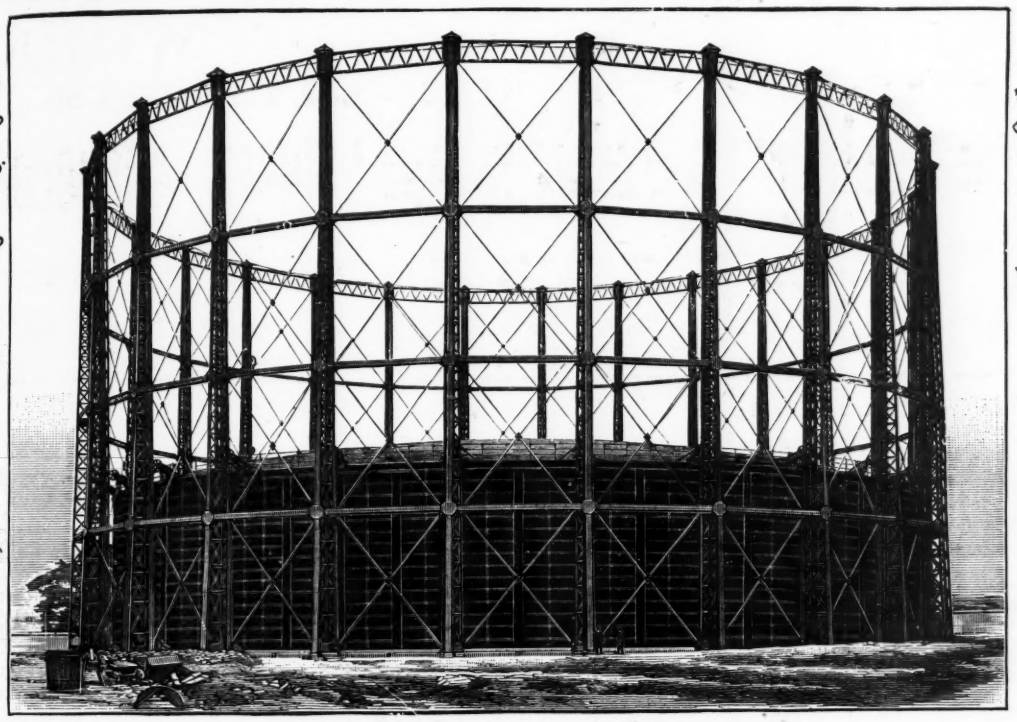

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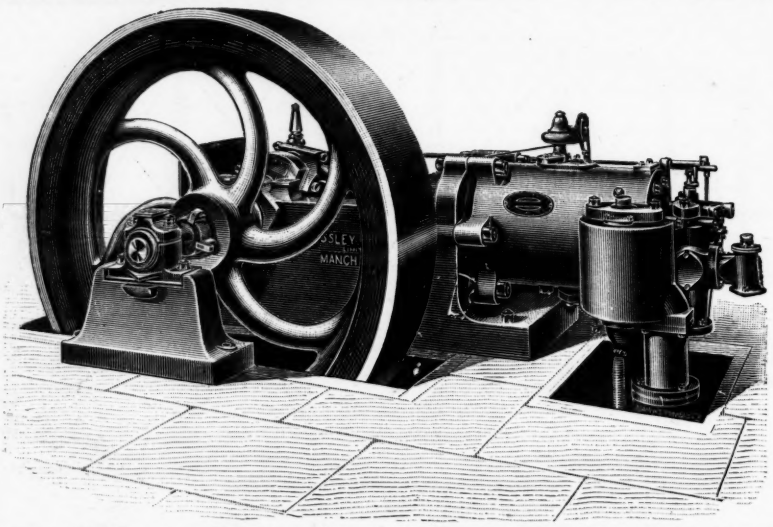

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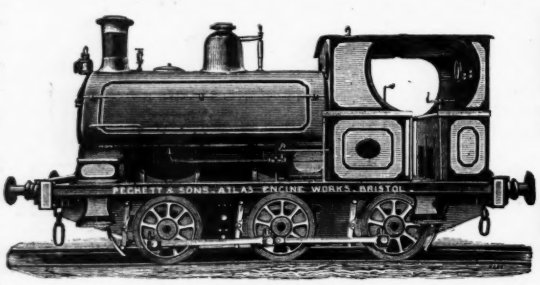


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Apply to the Sole Makers:
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**SILICA BLOCKS, BRICKS, AND CEMENT**
OF SUPERIOR QUALITY
**FOR GAS-FURNACES.**
Trade Mark: "SILICA."
**These Goods (largely used in Gas, Glass, Iron, and Steel Works) are, on account of their**
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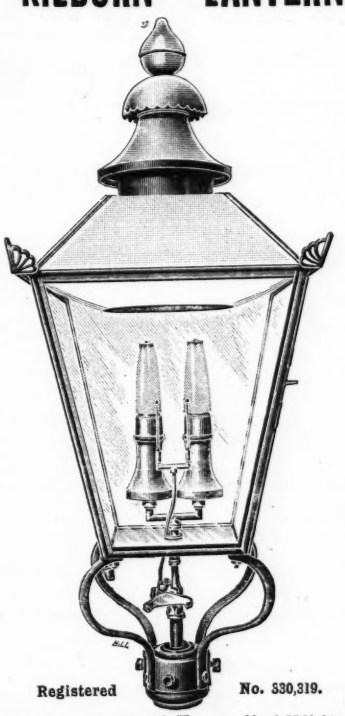

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**WELLS' LIGHTNING PAINTER**
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(Wallwork & Wells' Patents.)
**PAINTING BY MACHINE.**
**GREAT SAVING IN TIME, PAINT, AND LABOUR.**

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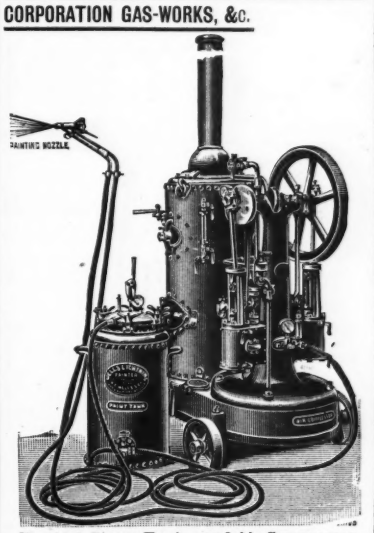

Vertical Steam-Engine and Air-Compressor combined with Boiler on Wheel Base.

**Price £100.**
**Larger size Engine, &c., adapted for working up to 4 Machines . . . £180.**
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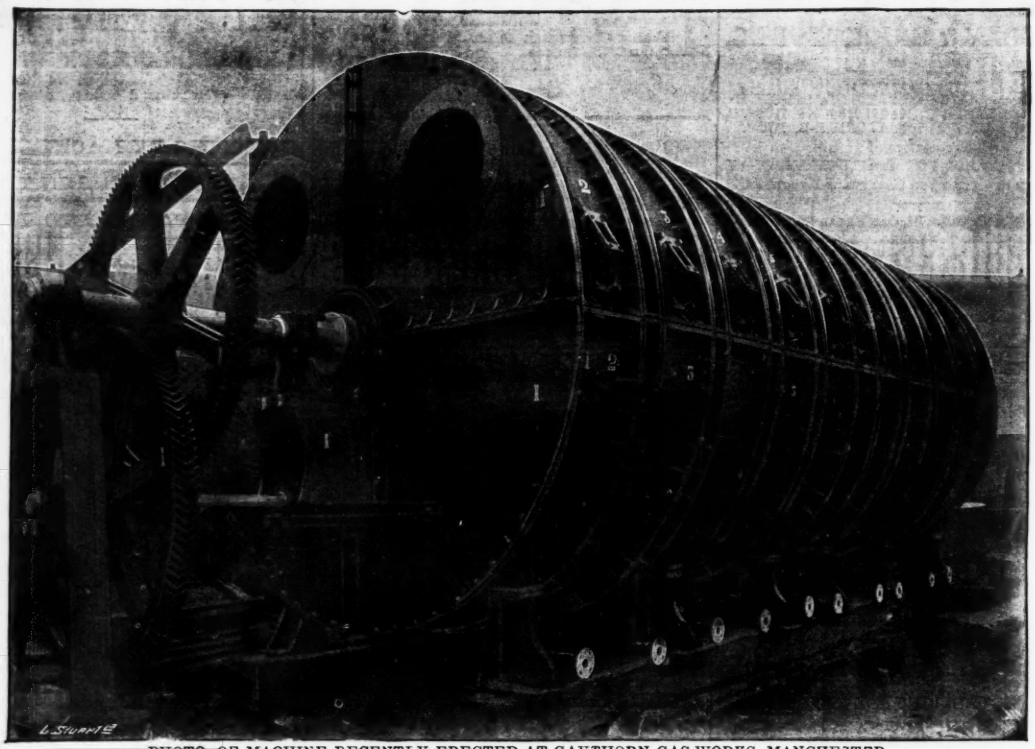

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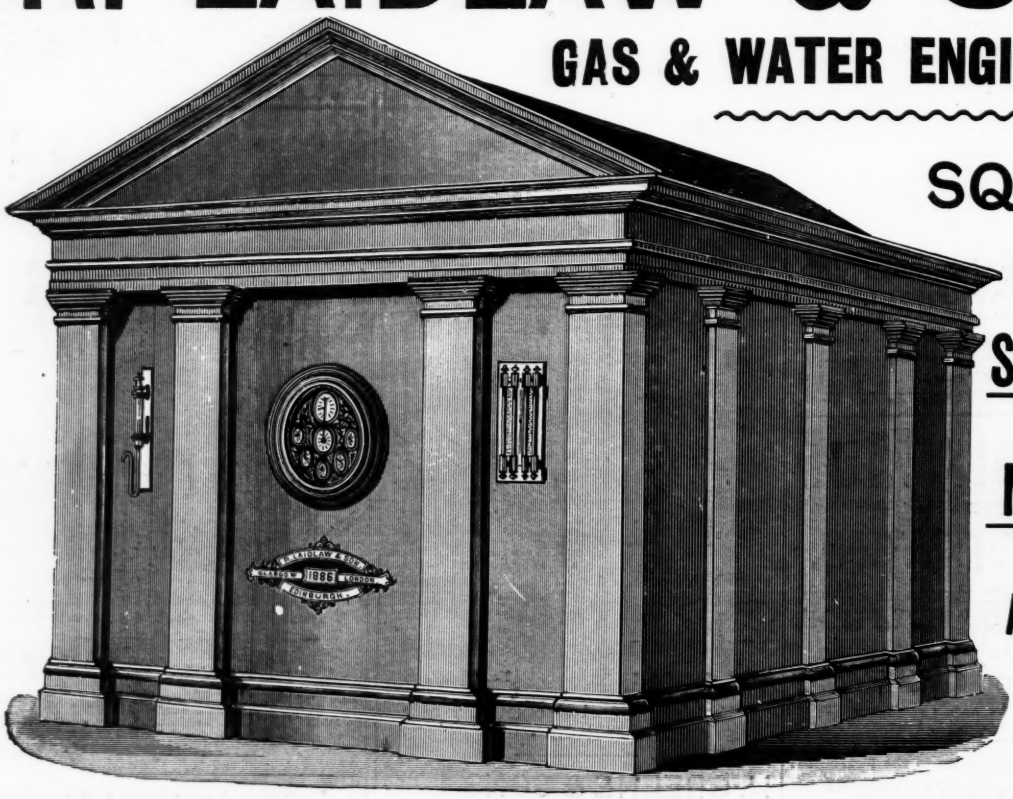

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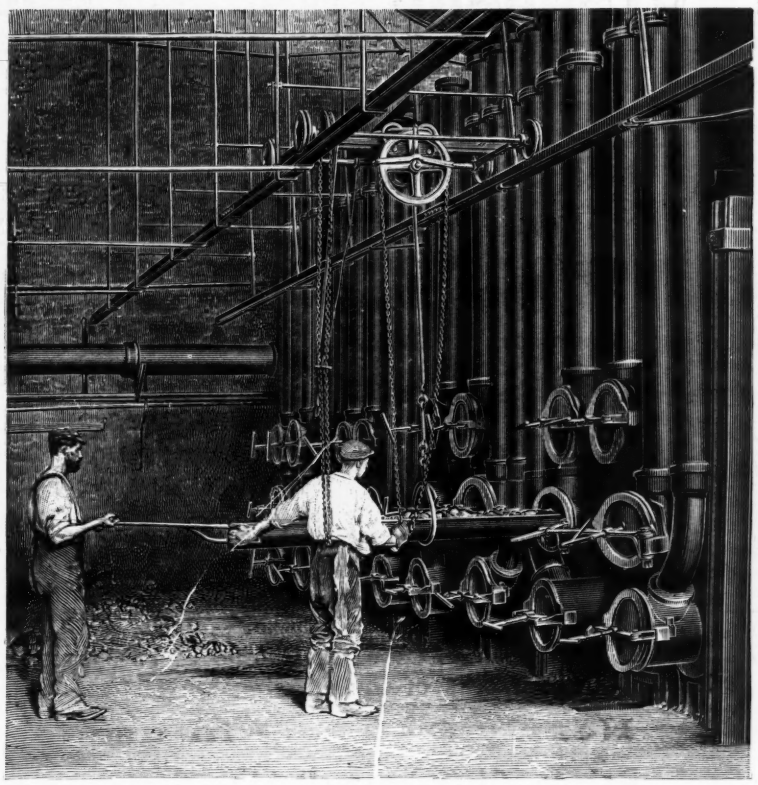

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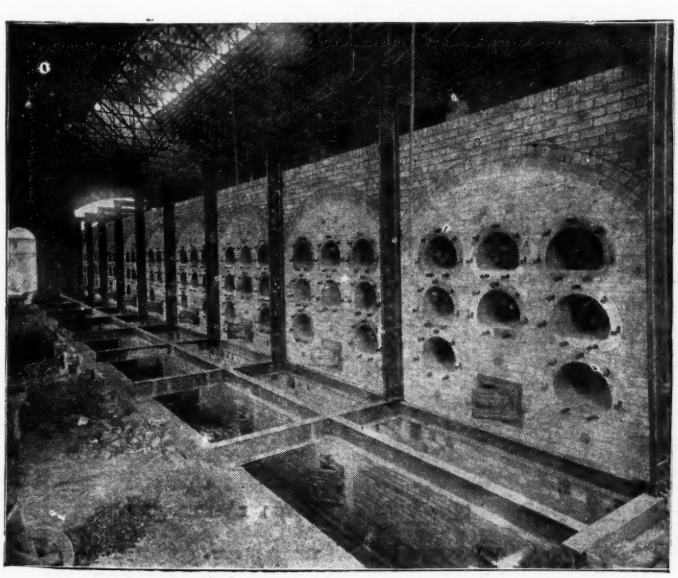

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## RETORT-SETTINGS

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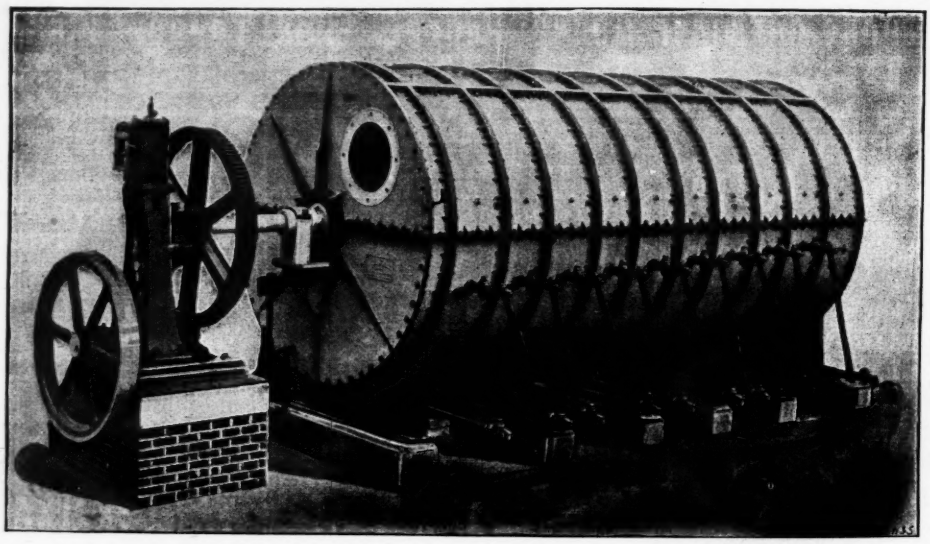
**Complete Extraction of Ammonia and large proportion of $CO_2$ and $H_2S$.**

Maximum Strength Liquor produced, Minimum Water Supply and Driving Power required.



Old Pattern Machines fitted with latest Improvements at Small Cost.

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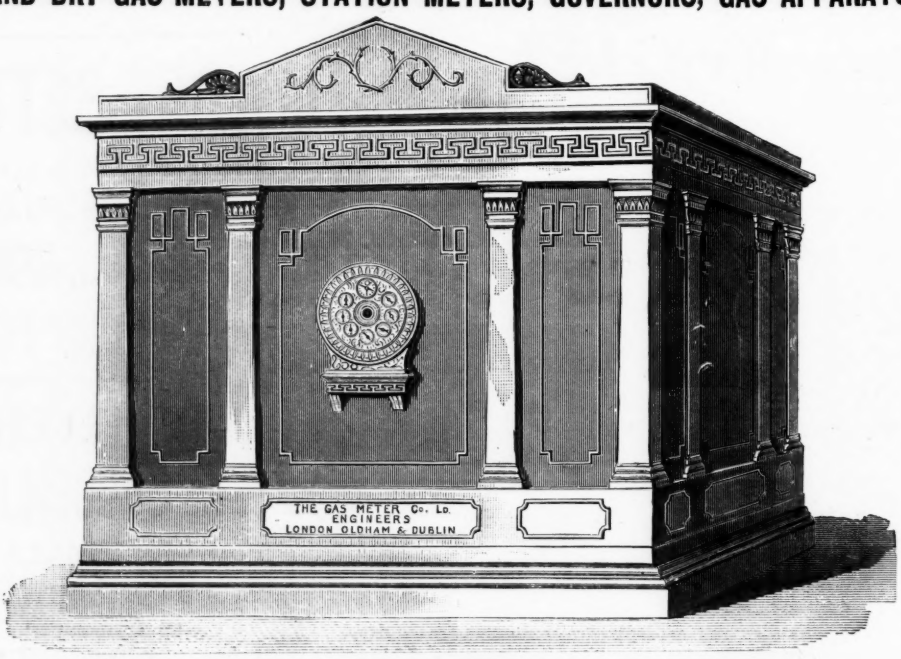
SQUARE STATION METERS WITH PLANED JOINTS.




STATION METERS IN CYLINDRICAL CASES.

DESIGN No. 2 PATTERN.

STATION METERS MADE AT THE COMPANY'S WORKS, OLDHAM (Late WEST & GREGSON). Established 1830.

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| Copenhagen (Second) | 2,500,000 | Edinburgh | 2,000,000 | Utrecht | 1,000,000 |
| Belfast | 1,700,000 | Guildford | 350,000 | Deventer | 150,000 |
| Belfast (Second) | 4,500,000 | Brentford | 1,200,000 | Portsmouth | 1,000,000 |
| Brussels | 700,000 | Syracuse, N.Y. | 850,000 | Bournemouth | 1,000,000 |
| Brussels (Second) | 700,000 | Bridlington | 125,000 | Aylesbury | 150,000 |
| Liverpool | 3,500,000 | Middlesbrough | 1,250,000 | Hamburg | 1,750,000 |
| Liverpool (Second) | 4,500,000 | Croydon | 1,250,000 | Redhill | 275,000 |
| Tottenham | 750,000 | L. & N.W. Ry., Crewe | 700,000 | Dublin | 2,000,000 |
| Tottenham (Second) | 750,000 | Taunton | 225,000 | Posen | 450,000 |
| Santiago de Cuba | 400,000 | Lawrence, Mass. | 400,000 | Dunedin (N.Z.) | 150,000 |
| Swansea | 750,000 | Commercial Gas Co. | 850,000 | Lincoln | 500,000 |
| Manchester | 3,000,000 | Commercial (Second) | 850,000 | Antwerp | 1,500,000 |
| Brighton | 1,750,000 | Commercial (Third) | 1,250,000 | Brussels | 1,000,000 |
| Preston | 1,500,000 | Rotterdam | 850,000 | Brighton (Second) | 1,850,000 |
| New York | 1,200,000 | Dorking | 125,000 | Stockport (Second) | 500,000 |
| Southport | 750,000 | McKeesport, Pa. | 500,000 | Croydon (Second) | 625,000 |
| Bath | 1,000,000 | G.L.&C.Co., Bromley | 3,750,000 | Maidenhead (Second) | 225,000 |
| Newburg, N.Y. | 350,000 | G.L.&C.Co., Nine Elms | 2,750,000 | G.L.&C.Co., Beckton | 2,250,000 |
| Newburg (Second) | 250,000 | Durham | 200,000 | G.L.&C.Co., Fulham | 1,750,000 |
| Hoylake | 125,000 | New York | 4,000,000 | Tottenham (Third) | 350,000 |
| Coventry | 600,000 | Scarborough | 800,000 | Sydney (Harbour) | 500,000 |
| Coventry (Second) | 600,000 | Perth, W.A. | 125,000 | Sydney (Mortlake) | 500,000 |
| Bordentown, N.J. | 125,000 | Bremen | 550,000 | Manchester (Second) | 3,500,000 |
| Winchester | 200,000 | Maidenhead | 225,000 | Hull | 1,500,000 |
| Shanghai | 225,000 | Epsom | 225,000 | Longton | 600,000 |
| Stockport | 500,000 | North Middlesex | 150,000 | Staines | 600,000 |
| Norwich | 1,000,000 | Wandsworth | 1,800,000 | Commercial (Fourth) | 2,000,000 |
| Holyoke, Mass. | 600,000 | Aarhus | 800,000 | Dublin (Second) | 2,000,000 |
| St. Joseph, Mo. | 750,000 | Falmouth | 150,000 | Faversham | 200,000 |
| Lea Bridge | 350,000 | Southampton | 800,000 | Birmingham (Swan V'ge) | 1,500,000 |
| Lea Bridge (Second) | 350,000 | | | | |

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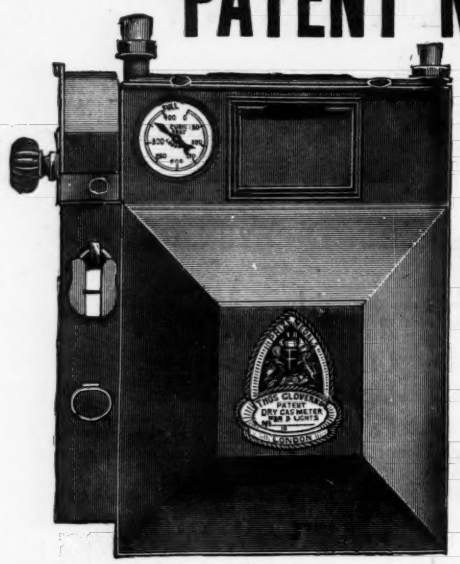

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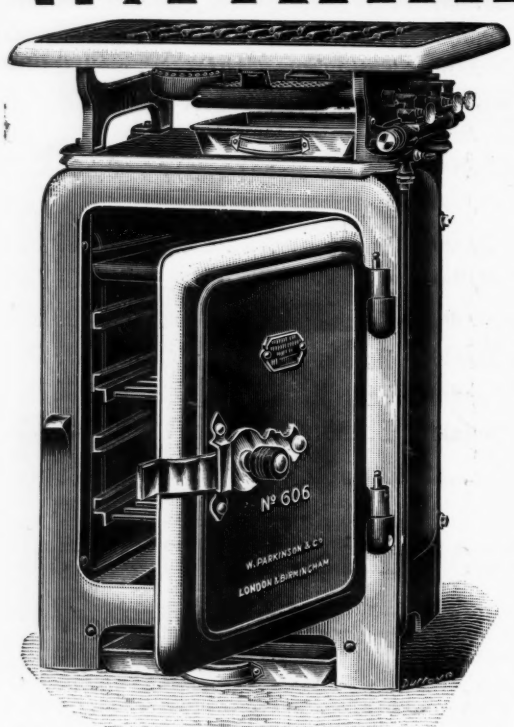


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## EDITORIAL NOTES.

### The Forthcoming Meeting of the Institution of Gas Engineers.

AMPLE evidence is afforded by the programme which has been issued for the forthcoming meeting of the Institution of Gas Engineers, noticed in another part of the "JOURNAL," that the President (Mr. J. W. Helps) and Council are determined that it shall be one of unusual interest. As will be seen, six papers on exceptionally good subjects are to be read and discussed, Professor V. B. Lewes will deliver a lecture on recent developments of water gas on the Continent, and there will be a visit to Woolwich Arsenal, some departments of which that are not usually open to the general public will, by special permission, be inspected. In view of the importance at present attaching to our armaments, this visit should prove particularly interesting and instructive. With regard to the technical matter, it is quite sufficient to refer to the titles of the papers to indicate its value. Probably the two questions which stand out most prominently to-day in connection with the gas industry are those bearing upon the enrichment—or shall we call it "adulteration"?—of gas with the view of increasing its value as an illuminant, and the better utilization of its calorific power. These subjects will be dealt with by Mr. George Livesey and Dr. H. G. Colman. Another matter which is always with us, and to which considerable attention has lately been given, is the presence of naphthalene in gas. Mr. Wilfred Irwin will have something to tell the members about its detection and extraction. Professor Lewes's exceptional abilities as a lecturer will be sure to render specially attractive what he will have to say on the subject he has selected; and the manufacturing and constructive papers by Messrs. C. C. Carpenter, S. Glover, F. W. Stevenson, and A. Baker, will furnish matter which cannot fail to lead to useful discussions. These, however, will not be allowed to absorb all the time at the disposal of the members, as the important question of the proposed amalgamation of the Institution with the Gas Institute will have to be dealt with—and it may be confidently hoped with satisfactory results. The social functions connected with the meeting will be a dinner at the Café Royal and another at the Crystal Palace. Altogether, the gathering promises to be an exceedingly interesting one.

### The Price of Coal.

THOSE Gas Companies who have still to purchase their coal supplies for the next twelve months are not finding any disposition on the part of coalowners to modify their terms. The tendency is rather for terms to become more, instead of less, unacceptable as time passes—or, to be literally accurate, we should say, more instead of less unsatisfactory. Gas managers are learning that, at the present time, it is the collieries, and not they, who can speak about "unacceptable" terms; and the coalowners, bent upon making hay while the sun shines, will hear no discussion, nor have much mercy—especially upon those who, in times gone by, have neither known when to be reasonable nor when to stop turning the screw. Human nature is a greater factor in business dealings than some people realize. It must, moreover, not be forgotten that the coal trade has but recently emerged from a period of considerable depression, when not a few pits were closed as too unprofitable to work, while some others were only kept going because the working loss was less than would have been entailed by closing the shafts altogether. This we mention, not as any good or sufficient reason for the collieries asking their present inflated prices—which are, we feel convinced, destined to bring their own retribution—but as explaining the eagerness of some few of the owners to work the present situation for more than it is worth. It is said that the masters, as well as the men, are showing a disposition to keep down the output of coal in order to keep up the price. This is an expedient to which the men have always shown a tendency to resort; but it would require very strong proof to make us believe that the masters are conniving at such a policy at the present time. Unless their prosperity has deprived a very shrewd body of men of their senses, the owners are only sorry that they cannot take fuller advantage of the present extraordinary demand.

We have said that the unreasonable prices now being asked for future supplies will bring their own retribution. Any artificial reduction of output would do so even more

surely, and from the same direction. For the certain consequences of enforcing such prices—obtainable by reason of the absolute necessity of coal for the conduct of many industries, but not really justified by the general level of the prices of other commodities—must be a restriction of trade, a contraction of the demand until the supply overlaps it, and then a rapid fall in the price of coal. There can be no doubt that the immediate result of the all-round increase in the price of gas which is taking or will take place, will be a check to the consumption of gas. Either the quantity sold will be actually reduced, or the increase will be at a less rate than it would have been at the lower price. Similarly, the price of iron, and of all goods made therefrom, or in the process of whose manufacture machinery or coal is used, must eventually bring about a reaction by checking enterprise and trade generally.

At present, however, the game is all in the hands of the producers; and, as we have said, the coalowners are playing it with great vigour and enjoyment. A reference to the figures in the Board of Trade returns for the three months ended March 31 will, in no small measure, explain the strength of their position. The exports of iron and steel during the three months were 966,188 tons, valued at £8,269,800, as compared with 708,653 tons, valued at £5,473,155, during the same period last year. The increase in pig iron exports was about 80 per cent. in weight and 150 per cent. in value. The influence of such a condition of the iron trade on the consumption of coal in this country is obvious. Side by side with the increased demand for coal at home, we see an export to other countries of 10·25 million tons during the first three months of this year, as against 9·7 millions in the March quarter of 1899, and 8·5 millions in 1898. The price realized this year, moreover, is 50 per cent. and more higher than during 1899. The increase in tonnage shipped over that exported in the corresponding months last year was, it may further be noted, 391,144 tons last month, as compared with 136,816 tons in February, and 55,189 tons in January. The increase is not in a diminishing ratio. For a great deal of this inflated demand, the labour troubles in Austria have been responsible; but, although the strike there has practically collapsed, stocks are at a minimum, and the output is certain to be restricted for some time to come. Further, the Baltic is only just opening for the summer trade; and, in view of the state of trade in Russia, there will doubtless be heavy shipments there of both coal and iron goods during the next few months. There is, therefore, but little prospect in the near future of any weakening of the position at present occupied by colliery proprietors. Gas shares this time next year will be better worth buying than ever.

### The Accounts of the London Gas Companies for 1899.

THE completion of the London Gas Companies' year, by the publication of the accounts of the Commercial Gas Company, enables us to present in this issue our customary statement and analysis of the accounts of the Companies for the year ending Dec. 31, 1899. So far as capital is concerned, the figures are necessarily affected by the process of conversion, and must therefore be interpreted in the light of their history. Capital stock conversion on the part of Gas Companies is a serviceable operation, and so is loan redemption by Municipal Gas Committees; but in both cases the result is to make havoc of comparative statistics. The "sweet simplicity" of the old maximum dividend *régime* was broken by the advent of premium capital; and now utter confusion reigns in its stead. The same remark applies to the revenue accounts, as affected by modern innovations in gas manufacture. This truth, however, while desolating to the comparative statistician, is valuable testimony to the fact of the gas industry being very much alive at all points. It is impossible to lay down in advance the lines along which the gas industry will next develop. Development may be hampered by mistaken or outworn regulations; but it cannot be forced by anything else besides changing circumstances and conditions. Nobody foresaw, twenty years ago, the expediency of those capital stock unifications and consolidations which have actually helped Gas Companies to cheaper capital; just as the modern expansion of gas consumption was not anticipated. Glancing at our page statement, it is quite a comfort to recognize in the returns for gas sold by meter—to the value of £4,328,049—a figure that has a solid, unchanging basis. This entry is greater by £169,700 than that for the previous year; the increase in the case of the Chartered Company alone being £133,100. The gross profit at which the undertakings work on this rental ranges from £39 12s. 6d. per cent. in the case of the Chartered, to £33 12s. 1d. in that of the South Metropolitan Company.

The income of the Companies from public lighting shows a general decrease—partly due, no doubt, to the economy of gas effected by the incandescent burner. The increase from residuals was enormous; amounting to £322,908 for all the Companies. The total increase of the Companies' revenue, from all sources, was just under half-a-million sterling—a plain proof of the vitality of the gas business in London. On the other hand, the positive cost of carrying on the business rose considerably. Although the era of dear gas coal and oil had not set in, the Companies had to pay £293,463 more for their supplies; and everything else went up in its degree. The Companies paid for rents, rates, and taxes £318,522; this being nearly £15,000 more than for the previous year. The carbonizing work of the Companies is exhibited in the accompanying small table:—

TABLE *showing the Residuals produced per Ton of Coal and Cannel, and the Gas made per Ton of Coal, Cannel, and Oil, by the Metropolitan Gas Companies in the Year* 1899.

| Name of Company. | Coke. | Breeze. | Tar. | Am. Liq. | Gas. |
|---|---|---|---|---|---|
| | Cwt. | Bushels. | Gallons. | Gallons. | Cub. Ft. |
| CHARTERED . . . . . | 12·42 | 3·07 | 10 29 | 31·09 | 10,662 |
| COMMERCIAL . . . . | 12·24 | 5·53 | 12·77 | 32·66 | 11,613 |
| SOUTH METROPOLITAN . | 12·34 | 4·67 | 9·60 | 33·06 | 9,854 |
| Mean per Ton . . | 12·38 | 3·74 | 10 20 | 31·82 | 10,478 |

The differences of manufacturing practice between the Companies are known to be considerable; but it is a surprise to see how seriously these affect the make of gas. Evidently, statutory 16-candle gas can be produced in various ways. With this reflection, we prefer to leave the table to speak for itself to those who can interpret it aright.

### For the Suppression of Illicit Commissions.

THE Lord Chief Justice's Bill for putting down illicit commissions has been read a second time in the House of Lords The print of the measure is prefaced with an explanatory memorandum, which states that the object is to check these inequitable and illegal secret payments by making them criminal. The use of these terms is very significant—inequitable, illegal, criminal. They form a trilogy which exhibits in a stern progression the descent from the ethical to the penal treatment of an offence. Those who rule their conduct by the law of righteousness, do not want any other deterrent from a practice than the knowledge that it is wrong. Those who are less scrupulous come within the scope of the civil law, which has power over their pockets, if not over their conscience. Where this restraining power is insufficient, and illegality takes the darker hue of corruption, the Sword of Justice only remains to terrorize and punish evil-doers. There is no doubt that corrupt secret payments to agents do demoralize all parties concerned, and discourage honest trade and enterprise. The gravity of the action depends wholly on the existence of this corrupt quality, and the mischief done is not confined to the question of degree. No attempt is made to define "corruption," in this regard; because the thing is so protean as to defy useful definition. The Bill goes quite far enough in the way of particularizing, in specifying that the consideration corruptly tendered, asked for, given, or received must be "valuable." Care is taken, however, that the word "valuable" is not to be construed in the ordinary sense, as a definition of degree. The words "valuable "consideration" in the Bill are to include "any money, gift, "loan, office, place, employment, fee, reward, benefit, or "advantage whatsoever, and any forbearance to demand "any money or money's worth or valuable thing." This is pretty wide. The sense of proportion, however, is sought to be preserved by the insertion of a list of exceptions to what are to be estimated as "valuable considerations" within the meaning of the Act, which comprise gratuities to servants and porters, and "meat or drink or accommo- "dation reasonably and *bonâ fide* given by way of hospitality "only." The business relations of donor and recipient are to determine the character of the gift, not its intrinsic value. If the Bill becomes law, a good many worthy individuals will have to seriously consider various things. The preferential

allotments of shares in some companies are a very long way from the periodical salmon, or the occasional box at a theatre, which incidentally punctuate business connections; but they all come within the range of this Bill. After all, the way of safety will be the rule of common sense. The canker of secret bribery has penetrated so deeply into all commercial life, from remote antiquity, that it will be difficult to eradicate. Contrary to what bookish people who contribute to newspapers may say on the subject, the evil is diminishing, not increasing. It is very like drunkenness. From ranking as the venial weakness of the many, it has descended to be the shameful indulgence of those, be they numerous or few, who are content not to be on the up-grade of humanity. Like drunkenness, venality will always remain in the world. It will continue to affect people of all grades of the community; but it is already disreputable. This is the opportunity for legislation, which is quite competent to save from themselves those who are weak rather than wicked, and to set the policeman on to the remnant that fears nothing else.

### The Waverley Association Meeting.

THE members of the Waverley Association of Gas Managers have good reason to be pleased with their meeting at Selkirk last Thursday—the only drawback to it being the breakdown of the weather, which necessitated some curtailment of the excursion. Mr. M'Lusky's presidential address was, as six months ago he promised it would be, a following out of the line of his then remarks. He takes up no subject to which he does not bring the touchstone of experience, based upon mature reasoning. He was thus successful in laying the foundation for a discussion of better volume and quality than is usually met with at meetings of the Waverley Association. It is almost a repetition to say that the subjects dealt with were of the ordinary work-a-day sort; but, were it otherwise, the Association would not be fulfilling its mission. There was no travelling beyond the topics which were suitable for managers of works of limited output. The Waverley men are somewhat of a family party—their interests being so much alike. For instance, the reduction of the illuminating power of Scotch gas, which, the week before at Glasgow, was looked upon with such general favour, was differently treated at Selkirk. In the Waverley district, the Newbattle cannels are near at hand; and all the arrangements of gas plant have been made for the supply of gas of high illuminating power. Any change in the quality of the gas would mean costly changes in the plant; and it is highly probable that the consumers in small towns, where customs are held to with tenacity, would oppose the change. The Waverley managers are, therefore, at present against a reduction. They are, however, taking largely to modern methods of consuming gas; and in doing so they are adopting the means of educating, not so much themselves as their customers, in the matters which have led to the subject of reducing the illuminating power being raised in other districts. That managers should be so enterprising as these are in the promotion of the use of gas-cookers and incandescent burners, and should be so advanced as they are on the free-burner question, is unmistakable evidence that the business of gas supply is not stagnating in the district. In the south-east of Scotland, the day of small things is by no means synonymous with the day of decaying things.

### Should Exported Coal be Taxed?

IT will most certainly strike many habitual readers of the "JOURNAL" that the time is suitable for a thorough reconsideration of the economics of the coal trade of the United Kingdom. Many people of late have asked themselves what would be the result of laying a prohibitive duty on the export of British coal; and in the name of all plain men who would like to understand the rights of this matter, we invite those who have any claim to speak with authority on the subject to offer their reasons in the "JOURNAL" why exported British coal should not be charged with a 50 per cent. *ad valorem* duty. This is an age of reconsideration of many doctrines. It is certainly not an age when the dicta of arm-chair Economists like Ricardo and Mill are accepted without question. There is much attraction in the remarks of the "St. James's Gazette" of last Thursday on this question of taxing coal exports. Our contemporary admits the principle that the prosperity of a commercial nation largely depends on it maintaining an increasing volume of exports, and also that imports can only be paid for by exports. This is all very well, so far as it goes; but in respect to the exportation of English coal, the consideration occurs that this is, for all we can see, a unique gift of Nature to these islands, upon the possession and proper use of which, under Divine Providence, the very existence of the Empire depends. "Coal is not like "any other raw material of trade. The consumption can-"not be made good by further and indefinite production. "The supply is a fixed quantity." The United Kingdom is in the position of being a besieged community. The nations are snapping and snarling round the present limit of our gun-fire. Is it wise and proper to send away so much of our source of energy, that cannot be restored? This is the question. It has often been ventilated before; but here is an opportunity for examining it again, in the light of contemporary events that are counter to all the premisses of the economics of the schools. There is no sort of economic reason for our fighting for the Flag in South Africa; but there is fighting, all the same. France, to whom we are the largest and best of national customers, ought, on the Cobdenish theory, to be our best friend; she is something altogether different. Germany and Russia are bound to us in the bonds of an enormous trade—they wish for our defeat and humiliation, while they buy our coal. Is this right? If so, let it be proved once more in a way that reasonable men can freely accept without being influenced by any political prejudices. If the events and discoveries of the past six months do not affect the dicta of classical Political Economy in this matter, one would at least like to be assured of the fact.

### The Committee on Municipal Trading.

JUST before the adjournment for the Easter holidays, the House of Commons disposed of the order for a Joint Committee of both Houses of Parliament to inquire into the question of Municipal Trading, by agreeing to the resolution by a substantial majority. There is little to add to our previous remarks on the subject. Sir A. Rollit made a temperate speech against the appointment of the Committee, on the reasonable ground that it is impossible to draw a hard-and-fast line between what Municipal Corporations might or might not undertake. This parliamentary spokesman for the Association of Municipal Corporations made out a plausible case for leaving Local Authorities alone, to do what they thought expedient in the interests of their constituents. He came fresh from the annual meeting of the Association, which had adopted a resolution moved by a representative of Leicester, to the effect that Municipalities ought to be left untrammelled in this respect. The "JOURNAL" has the reputation of looking with no friendly eye on the trading propensities of Local Authorities; but it cannot be truthfully urged against us that we have ever made objection to the "principle" of this form of municipal activity. Our objections to the unregulated extension of the practice are of another kind; and some of them, at any rate, are not very different from what appears to be in the mind of Parliament.

It is felt to be high time to take a survey of the subject apart from the particular applications which come before Select Committees on Private Bills. It is more than probable that the question of instituting some such inquiry would never have arisen but for the ill-advised obstinacy of the Associated Municipalities in asserting a claim to the monopoly of every kind of undertaking in which they might engage with the money of the ratepayers. If municipal trading had never betrayed this tyrannical spirit, and if those who favour it had not made so great a parade of the profits to be realized in this way for the relief of the ratepayers, the House of Commons would not have been so sharply antagonized at the idea. If the Associated Municipalities are wise, they will take warning by the very fact of the appointment of this Committee by a majority of 74 in a House of 208, and drop the monopolistic and profit-making parts of their commercial programme. Then they will have a better chance of persuading Parliament of the disinterestedness of their proposals in this regard. It is a little too barefaced for a party who have so recently opposed cheap electricity supply, in the interest of municipal monopolies, to argue that they should have unlimited powers to appropriate any other public supply undertaking that they might fancy. It sounds innocent enough, for example, for the Sheffield Corporation to wish to provide Turkish baths for the poor. Doubtless, they need them; but what if the

practical effect of receiving permission to provide Turkish baths were to inspire the Corporation with the wish to monopolize the convenience?

It is to be hoped that, when the Joint Committee is appointed, the Gas Companies' Protection Association will be able to offer evidence showing how their acceptance of the status of traders has occasionally affected the relations of Local Authorities with Gas Companies. Such matters, for instance, as the main-laying trouble in St. Pancras are very much to the point. There are likewise known cases throughout the country, where irritating disabilities have been imposed upon Gas Companies in the supposed interest of the municipal electric lighting undertaking. The ideal of Municipalism is all very fine and high-sounding; but practically its operations find expression by the agency of all sorts of small fry in the shape of officials, whose narrow-mindedness is almost beyond belief. Again, Select Committees and the Government Departments want general guidance as to allowing Municipalities to exhaust their credit for trading purposes, when there are other matters for them to attend to; and the recognized danger of increasing the amount of labour directly employed by elective bodies is not to be overlooked in this connection. As we have just remarked, the probability that much will come of the labours of the Joint Committee is not great; but if the Committee is to effect any good at all, it will be by turning the cold light of criticism on the details of the administration and financial conditions of municipal trading. Chatter about the "principle" will be waste of time. The period for repayment of loans, the question of adequate and trustworthy auditing, the fairness of Corporation account keeping, the comparative success of the English and Scotch way of dealing with profits, the question of monopoly—all these are matters which the Joint Committee may deal with instructively.

### The Year's Revenue.

THE Board of Trade returns of the commerce with other countries constitute a very sure guide as to the condition of trade generally in the home markets; and, as our readers are aware, they have throughout the past twelve months been eloquent of the prosperity of the country. The final figures of the revenue of the United Kingdom for the year ended March 31 provide full confirmation of the inferences drawn from the returns (of the import and export trade) as to the activity of home industries. In April, 1899, the Chancellor of the Exchequer estimated the revenue for the then ensuing year at £111,157,000, or £2,821,000 more than in 1898-9. The actual Exchequer receipts amounted to no less a sum than £119,840,000, or £8,683,000 in excess of the estimate, and £11,504,000 more than the receipts the previous year. After allowing for the fact that the receipts from Customs and Excise were abnormally heavy during last month—owing to the rush to clear dutiable goods in anticipation of increased taxation—the figures quoted afford remarkable evidence of the good times at present being enjoyed by the country generally, so far as money-making is concerned. Were it not for the concurrent enormous expenditure in which the country is involved by the South African War, we might have looked for a considerable remission of taxation. As it is, the poor income-tax payer (and especially he whose income is derived from gas dividends, which never thrive in times of flourishing trade and high prices) will have a big bill to pay in the course of the next twelve months.

### Ugly London.

AN interesting little article in a recent issue of the "Londoner" refers to the familiar question of what is the cause of the ugliness of London and other English towns. The writer opines that it is "the climate." He refers to a lecture by Mr. Whiteing on this interesting topic, in which the cheering thesis was sustained that London is the ugliest city in the whole world, with the exception of Madrid. In the course of his address, Mr. Whiteing stated that "the frightful lamp-posts of London "had much to answer for." He is doubtless right; and this remark justifies much that has been advanced in these columns in the same connection. By the way, nobody appears to have noticed our recent apology for the painted façades of the Regency period of London architecture; and glazed terra cotta is ruled out of the London County Council list of appropriate building materials for the new mid-London street. Alas! the London authorities deny to the city the only hope for brightness in building! Of course, the climate is insular, complicated with coal smoke; which is certainly not peculiar to London. "Manchester is "dreadful. Birmingham staggers humanity. The stoutest "heart might quail before the apparition of Whitehaven "upon a wet day. To go into Preston towards nightfall "is an experience so painful that it can never be for-"gotten. Who has not cried aloud for death upon "arrival, in a November twilight, at Wolverhampton? "Who has not sighed for the eternal sleep when suddenly "confronted, in a wintry dawn, with busy Blackburn?" Yet, somehow, one has the impression that this is not the whole truth of the matter. Exclusively manufacturing centres do not count in the category which includes Naples, or even Paris—which is a much overrated city as regards beauty. But London! Stand on one of the bridges at nightfall, when the lights are twinkling out. Drive through the Park precincts, at early dawn or dewy eve. Tread those streets which are the most varied in the world for architecture and use; and then pronounce London ugly! Yes, in many aspects and senses London is intensely ugly; and it has a way of exhibiting its very worst side towards the visitors and strangers who nevertheless come to it from the ends of the earth. Yet the man who does not prefer London to "Tetuan upon its flowery hill," is a soulless being upon whom it were futile to waste a second query. Still, London could do with local authorities more solicitous for its little things; and especially the lights, lamp-posts, and lighting might be improved. By the way, the South Metropolitan Gas Company have brought out a new pattern of street lamp-posts, with pentagonal lantern, which, as will be seen by the illustrated description given on p. 1002, is distinctly good.

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**The Coal Contracts of the London Gas Companies.**—It is understood, says the Newcastle Correspondent of "The Times," that about 400,000 tons of the Gaslight and Coke Company's contracts have now been arranged for at c.i.f. prices equal to from 15s. 9d. to 16s. f.o.b.; and that negotiations for as much more are now in close treaty at about the latter figure, which shows an advance of 6s. 6d. to 7s. a ton upon last year's rates.

**Stating Mileage of Mains in the Board of Trade Returns.**—In view of the practices of Secretaries of Gas Companies differing in regard to stating the mileage of mains in their districts for the Board of Trade Returns—some giving the length of pipes, and others the extent of the streets occupied—Mr. E. Ransome, of Bedford, has applied to the Board for a definition of the heading "Length of Gas-Mains in Miles" in the returns. The Board of Trade have replied as follows: "In view of the terms of the heading, the Board are of opinion that the actual length of the mains of the company, and not the length of streets in which such mains are laid, should be given."

**Thawing Frozen Water in Pipes.**—The "Ironmonger" calls attention to a practical application of the scientific truth that copper and brass are better conductors of heat than lead. If a length of lead pipe carrying a stopcock is evenly exposed to cold weather, as on the wall of a cellar, it always freezes first at the cock; and if the stoppage be observed in time, a flannel full of boiling water, or a bunsen burner, applied to the cock itself will generally make the water run again. This treatment can be pursued without fear of making a mess, because a pipe is not often burst if the freezing takes place slowly and progressively. The burst is caused by the expansion of the freezing water occurring in a closed length of pipe—*i.e.*, between two shut valves or between two plugs of already formed ice—or else so rapidly that the water still liquid has not time to get out of the way.

**Absorption of Light by Glowing Gas.**—In the current number of the "Electrician," M. Fournier de Albe devotes one of the interesting abstracts he is furnishing to that publication, under the heading of "Contemporary Electrical Science," to a paper by M. Cantor in the "Ann. der Phys." He says: "Kirchhoff's law makes the ratio of the emission of a gas to its absorption constant, and equal to the emission of an absolutely blank body at the same temperature. This law, as we know, holds for all flames so far examined. The question whether it applies to electrically glowing gases in a vacuum tube has been raised by M. Cantor, and answered in the negative by an important experiment. He sent a stong beam of light through a vacuum tube from end to end and back, and compared its intensity with a beam passing through air under normal pressure. After making suitable allowance for the illumination due to the vacuum tube itself, he found that the beam of light suffered no absorption in the electrically glowing gas. This result is of far-reaching importance. It could only be squared with Kirchhoff's law by supposing the gas to possess an extremely high temperature. This, as we know, it does not possess. Its temperature is more like that of boiling water. Therefore we must conclude that we have here a case of emission practically without absorption, and that the light-yielding mechanism is of a totally different nature from that of ordinary flames."

# ESSAYS, COMMENTARIES, AND REVIEWS.

## GAS AND WATER COMPANIES IN THE STOCK MARKET.

(For Stock and Share List, see p. 1013.)

BUSINESS on the Stock Exchange in the truncated week which precedes Easter is usually on a very slender scale; and this year it was no exception to the general rule. Attention was for the most part concentrated on the fortnightly settlement; and when operators had once closed their books, they took their departure until the holiday interregnum should be over. Thus business dwindled down; and things became quieter and quieter until by Thursday, the clock had almost run down. But still, on the whole, prices kept their ground very fairly well, when allowance is made for the natural shrinkage caused by realizations to secure profits. Some disposition to tightness, too, proceeded from the Money Market, where there was a very lively demand all the week. Commencing with the instalment payable on the War Loan, and continuing with the requirements of the Stock Exchange, money was in brisk request at advanced rates. In the Gas Market, transactions were on a most limited scale; and at no time was there any semblance of a disposition to activity. An inclination to do nothing at all just now is quite intelligible. The immediate future of Gas Companies' dividends is necessarily menaced by the abnormal price of coal, and therefore possible buyers of Gas stock may stand aloof for a time, while holders, confident of the value of their undertakings, may with equal caution decline to part with them at present prices. But quiet as business was last week, there was some further shrinkage of values, but not excessive; and in the case of one issue, which has lately been falling, there was a recovery. In Gaslights there was no alteration, the ordinary selling at good medium figures daily. The secured issues were steady too. The few transactions marked in South Metropolitans showed no fluctuation; but the quotation was put down a point. Nothing was done in Commercials; and the *ex-div.* adjustment of the quotation exhibited no falling off. Among the Suburban and Provincial Companies, was the unusual incident of several dealings in Bromley. Here prices were kept up firmly. Brentford and Crystal Palace, however, had to recede. In the Continental group, a little business was done in Imperial at poor prices; but the quotation did not move. Union ordinary recovered some of its losses; but the preference was weaker. Among other changes, Melbourne bonds were put down a couple of points; and Cape Town lost some of its advance. Hardly anything was done in the Water Companies; and their prices are practically unchanged.

The daily operations were: Business on Monday was of the most limited description; but prices were very fair. Crystal Palace ordinary and preference lost 2 each. There was an approach to more activity on Tuesday, but not much. Continental Union rose 5, but ditto preference fell 3, Brentford old 5, and ditto new 3. The general situation was unchanged on Wednesday. South Metropolitan fell 1, and Cape Town ½. Thursday was quiet, but pretty steady, save that Melbourne 5 per cent. bonds fell 2. The Stock Exchange was closed on Friday and Saturday.

## ELECTRIC LIGHTING MEMORANDA.

**The Wright System of Charging for Electricity—Preferential Trading Avowed—The Statutory Obligation of Fair Dealing—Unreliability of Meter Systems.**

AN instructive paper on the various methods in vogue of charging for public electricity supply, was recently read by Mr. Lackie before the Glasgow Section of the Institution of Electrical Engineers; and an abstract of it, with a brief report of the discussion, appeared in the "Electrician" for the 6th inst. Editorial notice was also taken of the paper; our contemporary pointing out that municipal committees controlling electricity supply undertakings are "not always clear" upon the bases of the Wright method, which is now so popular. This lack of understanding is said to be shown by cases where disproportionate reductions in price have been made, "especially at the time of the taking over of a supply works by a municipality—and by the frequent supply of electrical energy below cost to large consumers." We always suspected that this sort of thing goes on; and it is gratifying to have the suspicion confirmed on such good authority. It is kind of our contemporary to assign the proceeding to lack of understanding of the Wright device on the part of the municipal electricity supply committees; but we entertain another suspicion—that these bodies are inspired also with a very clear appreciation of the expediency of doing the popular thing. They may not always understand the Wright system; but they know very well they are expected to give patent proof of the advantage of municipalization, and soon learn the need of squaring the big consumers.

It is extremely interesting, moreover, to find the "Electrician" itself confessing that "even the Wright system does not give the absolutely correct theoretical charge that should be made to each consumer," and suggesting a simplification of the method in the shape of employing demand meters for a year or two, to test the nature of the requirements of the various classes of consumers in a town, and afterwards charging each at a single rate. It is regretfully admitted, however, that this would be in contravention of the Board of Trade regulations against preferential rates of charging. The Wright system is characterized as being "probably the nearest approach to preferential charging that the Board of Trade would tolerate"—a very significant admission. In point of fact, this "lets the cat out of the bag." If further proof of this were needed, it would be furnished by the statement which follows, that Mr. Lackie's tables will afford a guide to canvassers "as to which are the most and which the least desirable classes of consumers." If this is not a direct incentive to preferential dealing, we should like to know what would be so classified. This making fish of one consumer and flesh of another, is a transgression against the spirit, as well as the letter, of the Electric Lighting Act, which in this respect agrees with the whole body of British legislation relating to public supply undertakings. What right has a statutory undertaker of electric lighting to have classes of consumers of various degrees of "desirability," from his point of view, and to treat them accordingly, while railway companies, gas and water companies, and all other traders carrying on their business under the protection of an Act of Parliament dare not recognize any such distinction?

We have sometimes called the maximum demand system of charging for electricity a device—and have occasionally termed it a "dodge." In so far as it is preferential charging, it is clearly illegal. Of course, outside an Act of Parliament, a trader can show as much favouritism as he pleases, to himself or to any of his customers. The leading case of the Mogul Steamship Company established this liberty, if it needed any establishing. It is only by a Special Act that uniform dealing can be ensured; but when this is understood to be the common principle of an entire body of statutes, it seems risky, to say the least, to fly in the face of it. There are such things as injunctions; and the Board of Trade may wake up one fine morning and put a stop to all fancy methods for making one man pay more for his electricity than his neighbour and fellow. We have never taken to the maximum demand system, and have always applauded those purveyors of electricity who will have nothing to do with it. Preferential trading is more than non-statutory; it is repugnant to British notions of fair dealing. The United States is the home of it. In that fair land of Freedom, nobody can say what the price of gas is, or what it will cost to send a truckload of oil any distance. Some people pay more, some less. These things are all subject to "deals" of as infinite variety as Cleopatra's charms. Doubtless, as the greatest of Presidents observed of something else, "for those who like that sort of thing, it is just the sort of thing they do like." But it is not the thing that an English merchant would pride himself upon.

We may be accused of vilifying the maximum demand system of charging, because it is calculated to make electric lighting popular, and therefore a more formidable rival to gas where it is in vogue. The gas industry would not, however, suffer harm from the cheapest possible electricity, much less from electricity only made to look cheap by a dodge. The real truth about charging for public electricity supply has never been told by those in the business. The Glasgow Corporation have made a bold attempt to solve the difficulties of selling electricity by meter and indicator, and all the rest of it; and by one of their methods, they offer to cut the whole thing down to what is really a rental charge. If the consumer will engage to pay for a quantity of electricity computed on his maximum demand for the equivalent of five hours per day, for 365 days in the year—that is, for 1825 hours per annum—he gets it at a uniform rate of 2d. per unit. This is business; but the rest is to a considerable extent guesswork. There is no fixed relation between the station output and the readings of the consumers' meters. The two quantities—if quantity is the proper term to use—may agree fairly well, or they may not. There is nothing to lay hold of in the "unaccounted for" of an electricity supply undertaking. We have heard a whisper that a first attempt to apply the maximum demand system on a rigid instrumental basis resulted in a crop of 80 per cent. of disputed accounts; and that the peaceful working of the business afterwards could only be obtained by allowing a good deal of elasticity in adjusting of the quarterly charges, some of which ultimately bore more relation to the personal equation of the customer than to the number of units registered against him, or the nominal price thereof.

**Coal Exports in the Past Two Years.**—A parliamentary return just issued, giving the quantity of coal exported from the United Kingdom in the past two years, is of special interest in the present condition of the coal market. It shows that in 1899 no less than 41,180,300 tons of coal were sent abroad, as compared with 35,058,430 tons in 1898—an increase of 6,121,870 tons. The various groups of countries comprised in the summary statement in the return all took more coal from us last year, with one exception—viz., the group which includes British North America, the United States, the British West Indies, the Bermudas, the Foreign West Indies, Mexico, Central America, Colombia, and Venezuela; the figures being 405,486 tons in 1898 and 248,403 tons in 1899, or 157,083 tons less. British South Africa, on the other hand, had last year nearly twice the quantity imported in 1898—496,148 tons, against 258,150 tons. From Irish ports (Belfast and Cork), 1839 tons of coal were exported last year, the whole of which went to France. The quantity of coal shipped at each port for use on foreign voyages in 1899 wa 12,226,801 tons, compared with 11,264,204 tons in 1898.

## THE SUMMER INSTRUCTIONS OF THE METROPOLITAN GAS REFEREES.

THE thorough revision which the Instructions of the Metropolitan Gas Referees underwent two years ago, on the introduction of the Harcourt 10-candle pentane lamp as the standard for testing gas in London, has been followed by further emendations which have been noticed in our columns. They furnish evidence that the Referees are alive to the fact that conditions arise which call for verbal, or even more substantial, changes in the text of their half-yearly publications; and they make them accordingly. An instance of this is afforded by the Instructions for the summer of the present year, which reached us last Thursday. In addition to the usual notification that the maximum amount of sulphur allowed in gas will be 17 grains per 100 cubic feet, there are certain other changes to which attention may be directed. First in order is an entirely new section relating to the service-pipes to the testing-places. It runs as follows:—

Each testing-place shall be connected with the main or mains specified by the Gas Referees by a service-pipe, one service-pipe to each main, which proceeds directly from the street main or mains, and is without tap or branch, or provision for connection of any kind outside the testing-place.

If obstruction of the service-pipe is found, or if there is reason to think that the quality of the gas is suffering from a deposit of naphthalene, the service-pipe may be washed out in the presence of, and by arrangement with, the Gas Examiner, either by hot water alone, or by any usual solvent, such as benzol, naphtha, or petroleum; but the use of such solvents is to be followed by a washing with hot water. In every case where the service-pipe is washed out, the Gas Company shall send a letter to the Gas Referees, explaining why the washing was considered necessary.

No testing for illuminating power is to be made until after the lapse of an hour since the last washing out. The Gas Companies may, if they think fit, provide a tap and funnel in any testing-place for the purpose of such washing out.

The next change has been called for by the use of incandescent gas-burners for street lighting; and it has been made in the section of the Instructions dealing with the mode of testing the pressure at which gas is supplied. After setting forth that these testings are to be made at such times and places as the controlling authority may appoint, it is stated that, in order to make the test, the Gas Examiner is to unscrew the governor and burner of one of the ordinary public lamps, and attach in their stead a portable pressure-gauge. Then follow these directions:

In places where incandescent burners are used for street lighting, one street-lamp in each street or group of streets may be provided under the lantern with a branch closed by a screw stopper. The Gas Examiner shall in such cases connect the pressure-gauge by screwing it to an L-shaped pipe fitted with a union, by means of which it may be connected to the service-pipe in place of the screw stopper. The L-shaped pipe is to be of such dimensions as to enable the pressure-gauge to be fixed outside the lantern, but at about the same level as the incandescent burner. It should be provided with a tap.

The rest of the section stands as before.

A few changes have been made in the Appendices. In Appendix A—the description of the pentane lamp—some lines have been added to the fourth paragraph on p. 14, and a new paragraph has been inserted. This part of the Instructions now stands as follows:—

When the lamp is in use, the stopcock $S_2$ is to be turned so that the tip of the flame is about half-way between the bottom of the mica window and the cross-bar. A variation of a quarter of an inch either way has no material influence upon the light of the flame. *The saturator A should be placed upon the bracket as far from the central column as the stop at the end will allow. If it is found, after the lamp has been lighted for a quarter of an hour, that the tendency of the flame is to become lower, the saturator may be placed a little nearer the central column.*

The added matter is the portion printed in italics. Dealing with the dimensions of the lamp, the Instructions set forth that the outer diameter of the steatite burner is 24 mm.; the inner diameter, 14 mm.; and the number of holes 30—not less than 1·25 mm. or more than 1·5 mm. in diameter. This description is amplified by the statement that "the holes must be evenly spaced, and in any one burner they must not differ from one another in diameter by more than 0·05 millimetre." This question of the size of burner-holes crops up again in Appendix D—the description of Sugg's "London" argand burner, No. 1. It will be remembered that a full-sized section of the burner is given, with the dimensions in inches; the diameter of each hole being 0·045 inch. Referring to these figures, there is a foot-note to the effect that each testing-place will be provided with a box containing two wire gauges—one 0·044 inch and the other 0·046 inch in diameter; and it is stated that "the Gas Examiner must, once in every month, pass the smaller gauge through every hole, so as to clear out any loose obstruction or detect any hard concretion that might interfere with the proper discharge of the gas." It is added that he should at the same time "satisfy himself that the larger gauge will not pass through the holes." The last addition to be noticed is in Appendix K (the description of the Referees' street-lamp pressure-gauge), on p. 30; and it is necessitated by the insertion of the new matter given above. In the third paragraph, containing the instructions for making a testing of pressure, it is set forth that, in places where incandescent burners are used, the L-shaped pipe already described is to be employed for the attachment of the pressure-gauge.

The recent Instructions have been issued with a title-page and table of contents; and the document may now be purchased through the same agencies as parliamentary papers, at the price of 1s. 6d.—certainly a useful innovation.

## SUGGESTIONS FOR PATENT LAW REFORM.

IT is some time since the subject of patent law and Patent Office procedure was discussed in these columns; but it is a topic which no technical periodical can neglect for very long, because patents enter so largely into the development of every industry, and occupy so much of the professional mind. The "Engineer" recently published an instructive article on the drafting of patent specifications; and a suggestive paper on the patent system of this country was recently read before the Manchester Section of the Society of Chemical Industry by Mr. Levinstein. This gentleman ought to be able to discourse informingly on the subject, inasmuch as he has had a great deal to do with patents all his business life, and has further earned the gratitude of the country by being instrumental, at his own considerable expense, in setting in motion the Compulsory Licence clause of the Act. Manchester, as represented in this connection by Mr. Levinstein, is deeply interested in chemical patents, which are perhaps the most important of all in their bearing upon national trade, and are certainly also the most troublesome for everybody concerned. Mr. Levinstein was able to claim that Manchester has scored a point in the conversion of the President of the Board of Trade to the opinion that the Patent Act needs amendment. It will be gratifying news to many that Sir E. Fry has consented to preside over a Departmental Committee charged to find means for facilitating searches, and to enable patentees to learn whether or not their proposals have been anticipated.

This will be a good thing if it can be satisfactorily accomplished; and as to this it must not be forgotten that the idea of an official search for anticipations is discredited in advance by the Institute of Patent Agents. Mr. Levinstein dismisses this objection on the part of the Institute as arising from interested motives; but the criticism is not one to have much weight with business men. What has to be considered is, not only the interest of those who put forward certain views, but the value of the views themselves. In this instance, the advantage of an official *gratis* search for anticipations is so obvious on the face of it, that a wise man will be quite prepared to be told that it is entirely illusory. Such is the way of human experience. The Institute of Patent Agents point to American and German experience of official examination as proving that it is occasionally unjust to inventors, causes long delays and involves vexatious proceedings, and is of no value to the patentee after all.

If so much can be truly alleged against the principle of official examination of patent applications for novelty, then Sir E. Fry's Committee will have no difficulty in condemning it, and this particular fancy of would-be Patent Law reformers will be set aside. There is reason, however, in Mr. Levinstein's contention that what is bad in the American and German systems is not the principle, but the mode of carrying it out. Evidence will have to be gathered carefully to test this contention. It will be necessary to ascertain as exactly as possible how the system works where it is in operation; and to determine with equal precision how it ought to work. In the first place, one would suppose, the idea is to help the would-be patentee in the same way as he would help himself if he knew how, and were able to do it properly. This signifies that when application is made for a patent (say) for "a new illuminant appliance to be used in gas lighting," the applicant, knowing the nature of his alleged invention, wants to learn if it has already been patented by somebody else. At present he has to find this out by himself, or through his Patent Agent. The suggestion is that the Patent Office should do it for him—referring him in the result to the older patents that appear to a competent and impartial person to cover or touch upon his proposal. We cannot see the smallest reasonable objection to this programme, which, when acted upon with the ability, fairness, and courtesy that are honourable traditions of the English Patent Office, seems calculated to confer an enormous boon upon the inventor, and to give him a most ample return for his fee. Who that is interested in a particular branch of technics would not pay £3 to know what the records of the Patent Office contain relating to it? This is, indeed, one of the aspects of the question that have to be considered from more than one point of view. Can the Office afford the expense of providing such an informations-bureau? After all, the interest of the would-be patentee, whose ordinary motive is of an essentially selfish nature, is not everything in this connection. His object is to get a monopoly. Why should the State help him to it, as well as grant it to him, at his own risk? Knowledge is a commodity like any other; and others besides Patent Agents might object to the provision of a peculiarly valuable kind of information by a Government Department, for a quite unremunerative fee. The fee, besides, is here charged for something else, and the information is to be "thrown in," actually for nothing. It is a strong order.

Of course, it is urged in support of this request, that the Patent Office is a profit-making institution; and that some at least of the profit might be spared to help the poor inventor in the manner indicated. Even so, it does not necessarily follow that the poor inventor should be helped in this particular way. The trouble and expense might be thrown away upon him. Mr. Levinstein repeats the well-worn complaints that "by our present system the Government receives a large amount of fees for valueless services. It pockets from the poor inventors fees for patents which it must know are utterly valueless, and often for

subject-matters which have been patented over and over again. . . . Our system also encourages the taking out of bluff and bogus patents . . . and does not confer a shadow of a secure title, that a patent suit to establish may spell ruin to all but capitalists." How would official examination for novelty affect these considerations? Not at all, we are afraid; so that the case for such examination cannot rest upon them. As to patent litigation, this is no light matter anywhere; and it has never been proved that English law is either worse or less expensive than that of other countries. No patent law professes to give the patentee a sure title. The great majority of all patents everywhere are valueless; but those that are worth anything, like any other kind of property, will be fought over so long as they are worth attacking or defending. There is no likelihood that any sort or amount of official premonition will prevent the taking out of worthless patents; and is it probable that the traffickers in "bluff or bogus patents," if such there be, would be stopped by the Office? Besides, who is to be the judge of such matters?

It is a little doubtful upon which leg the professed advocates of the encouragement of patentees stand. The American boast is of the number of inventors who patent their ideas; while the German system has the opposite effect—the difficulty of obtaining a German patent being notorious. Which is the better result, even for inventors, it would be hard to say conclusively. There is much to be urged against the artificial encouragement of patenting, as tending to foster the lottery element in national industry. "Invent some taking notion, young man," is the stereotyped advice of the American Patent Attorney, "and then you need never do any more work." On the other hand, the German system is believed to be inspired with the sentiment that patent monopolies are an evil operating in restraint of trade, and as such are only bestowed for unquestionable and distinctly defined merit. This practically means that such a thing as a "master" patent is unheard of in Germany; most of the patents there being for details, such as are called in England "trade" patents. This consideration reminds us that Mr. Levinstein and some other patent law reformers seem to overlook the vast number of these patents. They would not possess any value in themselves, and they are never made the subject of litigation; but professional men often adopt this handy expedient for registering priority for an idea, and there are shopkeepers who make it a rule to advertise all their wares as patented specialties. Consequently, large batches of patents are taken out every year by inventors who do not require any official assistance.

If one gets away from the notion that patent systems are for the benefit of patentees only, and poses the larger question of whether the multiplication of patents is for the good or otherwise of the community generally, there is a formidable case for the opposition to these monopolies. It is very certain that many articles are extremely cheap in Germany, owing to the restricted patent system, which are injuriously dear in patent-ridden countries. Mr. Levinstein complains that we grant in England annually about 9000 monopolies in excess of those granted by Germany; but whether this is a good or a bad thing for inventors he does not say. That it is good for the German and bad for the British public he does not hesitate to aver; but this is a contention that might be used in disparagement of all patent rights whatsoever. A very clear grievance mentioned by Mr. Levinstein is the disconformity of the patent laws of the industrial and commercial nations. Take, for instance, the important example of patents of addition—those for improvements on the original subject-matter. In England, these additional patents are independent monopolies, and are used (whenever it is possible to do so) to eke out the life of the exclusive privileges of the patentee beyond the term of the original patent. In Austria, France, and Germany, additional patents expire with the originating one. The consequence is that the public of the United Kingdom are taxed to support a monopoly for years after it has lapsed across the Channel. It is unnecessary to dilate upon the disadvantage to the English nation of this one-sided arrangement. The matter becomes still more irritating, naturally, when the original patentee is a foreigner, and the English law enables him to go on drawing his royalties, and otherwise burdening our trade, while obliged to do business at home under competitive conditions.

Mr. Levinstein argues also that the facility for disclaiming, which exists under the English law, paralyses fruitful invention and checks industry. It is true that some of the strongest and most oppressive monopolies of recent times have been the result of this process, applied to originally weak patents. This remarkable result is aided by the apparently public-spirited provision of the Act, that no amendment of claims is permissible which widens the scope of the patent. But the practical effect is, that where a patentee has happened to employ a form of words which in the light of subsequent discovery bears a particularly valuable construction, he or his representatives are allowed to cut out every thing besides this one thing. Result—a valid patent where otherwise the patent would not have been worth the specification paper. Nobody can conclusively say that the patentee had not the particular application in his mind from the very first. The Courts will construe his specification and claims on their wording; and so this trick of disclaiming, apparently so innocent, is really a tremendous power which a body of extremely able practitioners know well how to employ to forge a monopoly out of a mere guess-word. The German system, with its requirement of samples and specimens in addition to specification and drawings, nails the patentee down to what he knows at the time. This is undoubtedly one of the points that will need attending to whenever the British system is overhauled.

We have discussed Mr. Levenstein's suggestions, which are extremely pertinent, at such length as to have left no space for dealing with the matter of the "Engineer" article. This, however, is really another branch of the general subject, and may well be treated separately. In these days, when so many men unaccustomed to precise writing are their own specification drafters, hints on the subject are certain to be acceptable.

## THE SCARCITY OF COAL IN THE SEVENTIES.

In view of the present abnormal condition of the coal market, it may not be without interest and advantage to consider what causes were responsible for the somewhat similar state of the market which prevailed in the early seventies, to which time we have to hark-back in order to find any approximate parallel to the present situation. The high prices ruling for coal at the commencement of 1873 caused so much dislocation of trade, and gave rise to so much apprehension for the future, that, on the 21st of February in that year, a Select Committee of the House of Commons was appointed "to inquire into the causes of the present dearness and scarcity of coal, and to report thereon to the House." Mr. Ayrton was elected Chairman; and the Committee—of which Mr. (afterwards Sir George) Elliot and the late Mr. Hussey Vivian (afterwards Lord Swansea) were members—after having examined a considerable number of witnesses, including colliery proprietors, merchants, retailers, mine inspectors, and representatives of the workmen, reported to the House on the 18th of July, 1873. The following is a brief summary of the conclusions contained in that report, together with the most important points in the evidence of some of the various witnesses examined.

The Royal Commission appointed in 1866 to investigate the probable quantity of coal contained in the coalfields of the United Kingdom, and the quantity of coal then consumed and exported, having presented in July, 1871, a voluminous report on the subject, Mr. Ayrton's Committee did not deem it at all necessary to inquire into any of the matters contained in that report—contenting themselves with referring briefly to some of the conclusions arrived at by the Commission, in so far as they had any bearing on the then prevailing condition of affairs. In order to ascertain the causes which led to the apparent scarcity of coal at the time of their appointment, the Committee sought, primarily, to ascertain how far the scarcity had arisen from a diminution or stagnation of supply, or from an unusual increase of demand for consumption, either temporary or permanent in its character. So far as the question of the output of coal was concerned, the Committee, from a consideration of the evidence laid before them, arrived at the conclusion that there had been considerable disturbance in the minds of the workmen employed in and about the mines, respecting the number of days or hours per week or per day during which they deemed it to their interest to work, and that the general tendency had been to reduce the hours of labour. It was further stated that the Mines Regulation Act, passed in 1872, had also tended to the same result; the consequence being a falling short of what, with normal working, would have been the possible output.

Referring to this fact, the Committee observed that they had "no reason to doubt that one of the greatest benefits which can be conferred on the mining population is to induce them to work with regularity day by day, and for such a time daily as—while it will not deteriorate their health, social comfort, or moral condition—will not result in idleness or dissipation; but as no standard can be laid down to fulfil these conditions, it must be left to the general feeling of the workmen, improved by education, to arrive, in concert with their employers, at the proper limits for their labour." These observations, made more than a quarter-of-a-century since, are equally appropriate to the present day; the "greatest of benefits" defined by the Committee remains to be conferred upon the mining population. But, as the desired end is only to be attained by inward change, it is not obvious with whom lies the power to confer. It is interesting to note that the output of coal per man employed in 1872—the year when unusually bad working was alleged to have been prevalent—was only 3 tons less than that in 1899, and was actually more than in the years 1897 and 1898. The figures are as follows:

| | | | |
|---|---|---|---|
| 1872. . . . . | 299 | tons | per man employed. |
| 1897. . . . . | 291 | ,, | ,, ,, |
| 1898. . . . . | 286 | ,, | ,, ,, |
| 1899. . . . . | 302 | ,, | ,, ,, |

The Committee then passed to the consideration of the consumption of coal; and found in the excess of the demand over the supply the real inwardness of the situation then, as is to be therein found the *causâ causans* of the situation at the present time. They reported that they found a very general concurrence of opinion among the witnesses they examined, that the flourishing condition of the industry of the country and of the population had fully sustained, and had even enhanced, the rate of increase of consumption of coal for the purposes of industry in general, as well as for domestic use. There was also an equal

agreement among the witnesses that the special branch of manufacture which had extended the demand for coal to a degree which could not be met by the producers, and which thereby led to the rise in price, was the manufacture of pig-iron and its conversion into the various forms of rolled iron; and, further, that this increase of demand came mainly from the United States of America and from Germany. The quantity of coal used in iron manufactures was shown to have risen from 28¼ million tons in 1867 to 38¼ millions in 1872; and the state of the iron trades, and its effect on the coal and coke markets, was very clearly put by Mr. Isaac Lowthian Bell, one of the principal North-country iron-masters. Asked whether he was of opinion that the source of the whole disturbance was in the greatly increased demand for pig, malleable, and manufactured iron, Mr. Bell said:

I do not say the whole cause; it was one of the causes. Of course, a coal-field which had no ironfield would not have been affected by it; but we know a greatly increased demand has been felt everywhere. With us, no doubt, the iron trade gave a great stimulus to the coal trade; and I think the coke in our neighbourhood rose in consequence much higher than the coke in any other district. But the fact is, all industry all through the country has been, and still is, I may say, in a very flourishing condition, and the iron trade with others. The manufacture of alkali in the North of England is in a very flourishing condition; and, again, the increase of railways, and the general substitution of steam for sailing vessels, all added to demands on an output not very greatly increasing, have, I conceive, led to the present state of things.

Then, in your view, it seems that the iron trade primarily, and other trades in a less degree, caused an increase of demand with greater rapidity than the production of coal?

Certainly, in the North of England, it was so. In September, 1871, forge pig-iron was selling with us for 50s., and coke was selling at from 10s. to 12s. a ton. Pig-iron rose gradually towards the end of the year to 64s.; but coke was not affected up to that time. In January, pig-iron rose from 64s. to 70s. 6d., and coke rose to 20s. In March, forge pig-iron was 84s., and coke was 25s. In April, pig-iron rose to 94s., and coke rose to 32s. 6d. In July, forge pig-iron rose to £5 10s.—more than twice what it was nine months before—and coke rose to 37s. 6d. and 41s. per ton. Now pig-iron rose in spite of the increase in the quantity made . . . and rose unexpectedly to us, just as coal had done to the coalowners.

The Committee, after quoting this evidence, referred to the fact that, then as now, the strong demand for coal for the particular industry of iron manufacture, reacted upon the supply for every other usage of coal, and exercised a marked influence over the price of all qualities. As the most striking example of the effect upon the price of house coal, the evidence of a London coal merchant was quoted, showing that the average prices for best house coal delivered at the wharf—as distinguished from the retail prices, some 5s. to 7s. per ton higher—in London were, for the first five months of 1873, and the five preceding years, as follows:—

| | | | |
|---|---|---|---|
| 1868 . . . . | 18s. | 7d. | 1871 . . . . 19s. 3d. |
| 1869 . . . . | 18 | 8 | 1872 . . . . 24 11 |
| 1870 . . . . | 18 | 6 | 1873 (5 months) . 32 6 |

while for two days in February, 1873, the price on the London Coal Exchange reached 45s.

Upon the effect of a comparatively small excess of the demand over the supply of coal in raising prices, the Committee made some very true observations, that should be borne in mind at the present moment. "The exact effect of any disturbance of the relations of demand and supply on prices, is beyond the limit of arithmetical calculation. Price depends not merely on the quantity of the commodity, but on the motives which influence both the buyer and the seller in determining how much the other is willing and able to pay, under the belief that the quantity brought to market is or may be insufficient to meet the demand. In the case of coal, much of the demand is of such an urgent nature that the buyer would pay a very large price rather than be deprived of the supply he requires. Nor does the ratio of increase of price necessarily bear any definite proportion to the ratio of diminution of supply. A comparatively small deficiency may produce a very large increase of price if the eagerness of each buyer to secure his own supply, and to guard against deficiency in his own case, be coupled with the ability to pay for it whatever is demanded by the seller. This appears to have been the cause of the comparatively small derangement in the production and consumption of coal enhancing its price in so great a degree."

The conditions named—absolute urgency for supply, and, practically speaking, ability to pay "any price"—exist in the case of gas companies; and the moral, it seems to us, is that those companies should, at all times and by every means in their power, keep themselves thoroughly well posted with the exact conditions subsisting—and obtain the very best advice as to the conditions likely to prevail—in the coal trade, in order to avoid the mistake either of waiting too long to buy when the demand is likely to exceed the supply—as the market hardens with lightning speed when such a condition of affairs is realized, and last comers pay top prices—or of buying too soon and too eagerly on a "hollow" market. If the London Companies had negotiated their contracts for 1900-1 last September or October, would they have had to pay the prices now asked for those supplies? We admit it would have required no small degree of courage to do so; but was not the activity in all branches of the iron trade patent months ago?

As to the proposals which were made then, as they are made now, that Parliament should interfere, either by way of regulation of the home trade, or of imposing restrictions upon the export of coal, the Committee declared that they did not believe that the interference of Parliament with the course of industry—beyond the prevention of injury to the health and morals of children and young persons, and the prevention of accidents from wilful neglect of recognized precautions—could produce any useful or beneficial result to the public.

The Committee further pointed out that there are special objections to an export duty on coal beyond those of the general policy of the country, which would not apply with the same force to many other commodities. "The coal exported to foreign parts is not for the exclusive use of foreign countries. A considerable quantity is used by English shipowners for their homeward and other voyages, while foreign steamships load coal at English ports for their own consumption. It would be just as injurious to the English shipowner, to the merchant whose goods he carries, and to the workman who makes them, to deny them the free use of English coal, as it would be impracticable to levy a differential duty on coal consumed in foreign ships trading with England. Even when the coal is consumed in the interior of foreign countries, it is not infrequently used on their railways to bring to their ports commodities (whether raw or manufactured) to be imported into this country to be exchanged for the exports from England, and all those operations would be prejudiced to the extent to which English coal abroad would either be enhanced in price or diminished in supply." Moreover, "if the result of an export duty on the coal itself deprived foreign countries of the means of manufacturing commodities in which coal is used, it would only have the effect of increasing the export of those commodities, and, consequently, of the consumption in England of the coal required for their production, unless there resulted a great diminution of industry and trade, and a cheapening of coal by depriving the people both of their power to use it in manufacture, and to purchase it for domestic use."

Finally, the Committee concluded their report by declaring that they believe "that the true policy of this country, and the best inducement to the proper conduct of business—as well as the greatest stimulus to a return to a more just balance between supply and demand—is to leave the trade free, and to maintain an inflexible resolution of non-interference on the part of the State. To adopt the opposite course would be to make one class pay for the benefit of another; while any restraint on the profits of private business or industry by the power of the law, must, in justice, carry with it the guarantee of the resources of the State against loss, which . . . is altogether impolitic." With this conclusion it is impossible to disagree; and all coal buyers must perforce recognize that the coal trade is, at intervals, subject to violent fluctuations, which are usually produced by apparently disproportionate, but none the less perceptible, causes; they must learn to anticipate such fluctuation, so far as it is possible so to do, by the exercise of judgment founded upon accurate information; and, finally, they may console themselves, at times of abnormally high prices produced by such causes, with the reflection that those times are inevitably followed by a return to average prices, the nearness of the reaction being inversely proportionate to the magnitude of the difference between demand and supply which has occasioned the inflation of prices.

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**Society of Chemical Industry.**—The annual general meeting of this Society will be held in London from the 18th to the 20th of July. The business portion of the meeting will be transacted at the Royal Institution, Albemarle Street, under the presidency of Professor C. F. Chandler, M.A., M.D., of New York. The afternoon of the first day will be devoted to visits; and in the evening the annual dinner will be held. Other visits will be arranged for the next day, ending with a reception by the Lord Mayor at the Mansion House. The last day will be spent at Oxford. Delegates from the Society will attend the International Congress of Applied Chemistry which is to open in Paris on the 23rd of July, under the presidency of Professor Moissan—M. Berthelot being the Honorary President.

**Tar Distillation in France.**—A recent number of the "Génie Civil" contained some particulars on the above subject. The tar distillers in the Paris district are the Paris Gas Company, who carry on this branch of their operations at their station at La Villette; the Paris Asphalte Company, who have two works, one at Pantin and the other at Chalette, near Montargis; and MM. Lassailly et Bichebois, at Issy-les-Moulineaux. These works annually distil about 62,000 metric tons of tar. In addition to a production of 60 to 65 per cent. of pitch, 20 to 25 per cent. of heavy oils, and 2 per cent. of non-rectified light oils, about 5 kilogrammes of pure anthracene and 90 kilogrammes of naphthalene are obtained per 1000 kilogrammes (2205 lbs.) of tar treated. Thus the Paris district produces in round figures from 37,000 to 40,000 metric tons of tar, from 12,000 to 15,000 metric tons of heavy oils, and about 1200 metric tons of light oils. In the North of France there are the Lens Mines, where there is plant for distilling tar from the coke-ovens, as well as other works. The production in the North only amounts to from 9000 to 9750 metric tons of tar, from 3000 to 3750 metric tons of heavy oils, and about 300 metric tons of light oils. A great deal of the tar of the North is distilled in Belgium. Not a pound of tar is imported into France, but large quantities of benzol are, as this product has only to pay a small duty.

## ACCOUNTS OF THE METROPOLITAN GAS COMPANIES FOR THE YEAR 1899.

| — | Chartered. | Commercial. | South Metropolitan. | All the Companies. |
|---|---|---|---|---|
| | £ s. d. | £ s. d. | £ s. d. | £ s. d. |
| Capital and borrowed money | 27,120,015 0 0(a) | 1,054,330 15 2 | 7,868,131 0 0(a) | 36,042,476 15 2 |
| Income—viz.: | | | | |
| Sale of gas by meter | 3,040,170 6 1 | 239,166 1 0 | 988,713 5 8 | 4,328,049 12 9 |
| Public lighting, including lighting under contracts | 148,428 15 10 | 20,110 15 8 | 62,255 8 10‡ | 230,795 0 4 |
| Rental of meters and stoves | 43,762 9 5* | 14,202 15 1 | 63,837 19 7 | 121,803 4 1 |
| Residual products | 919,659 0 1 | 81,974 16 2 | 470,739 13 11 | 1,472,373 10 2 |
| Miscellaneous, including old materials | 16,999 16 11 | 777 12 10 | 7,771 19 0 | 25,549 8 9 |
| Total income from all sources | 4,169,020 8 4 | 416,232 0 9 | 1,593,318 7 0 | 6,178,570 16 1 |
| Expenditure—viz.: | | | | |
| Coal and oil, including carriage and dues | 1,408,932 11 7 | 163,582 6 6 | 629,374 10 2 | 2,201,889 8 3 |
| Purifying materials, including labour | 69,864 7 7 | 13,835 3 10 | 31,275 11 2 | 114,975 2 7 |
| Salaries and wages—manufacture | 385,886 6 0 | 40,056 6 10 | 128,813 9 3 | 554,756 2 1 |
| Wear and tear—manufacture | 366,215 10 7 | 33,313 0 5 | 175,378 11 1 | 574,907 2 1 |
| Rents, rates, and taxes | 243,411 8 5 | 15,073 15 9 | 60,037 0 4 | 318,522 4 6 |
| Salaries—management | 22,660 0 1 | 2,458 13 8 | 4,800 0 5 | 29,918 14 2 |
| Collectors' salaries and commission | 40,751 0 5 | 3,978 4 8 | 17,099 1 1 | 61,828 6 2 |
| Stationery, printing, and general charges | 21,306 5 6 | 2,527 13 9 | 11,158 2 4 | 34,992 1 7 |
| Directors and auditors | 5,981 18 0 | 2,650 0 0 | 3,805 19 0 | 12,437 17 0 |
| Salaries and wages, wear and tear—distribution | 184,740 2 11 | 14,445 12 9 | 95,034 4 4§ | 294,220 0 0 |
| Repair and renewal of meters and stoves, &c. | 105,502 8 8 | 10,689 8 9 | 46,325 6 7 | 162,517 4 0 |
| Law and parliamentary charges | 4,829 8 7 | 482 6 4 | 1,153 14 4 | 6,465 9 3 |
| Bad debts and extraordinary expenses | 46,044 1 3† | 4,009 4 11 | 35,881 8 9‖ | 85,934 14 11 |
| Total expenditure on revenue account | 2,906,125 9 7 | 307,101 18 2 | 1,240,136 18 10 | 4,453,364 6 7 |
| Gross profit | 1,262,894 18 9 | 109,130 2 7 | 353,181 8 2 | 1,725,206 9 6 |
| Do. per cent. on capital and borrowed money | 4 13 2 | 10 7 0 | 4 9 9 | 4 15 9 |
| Do. do. gas-rental | 39 12 2 | 34 3 7 | 33 12 1 | 37 16 10 |

(a) Converted. * Stoves only. † Including annuities, £25,125, and £4545 on workmen's compensation account. ‡ Including £22,542 for lighting, repairing, &c.
§ Including £9179 labour for gas-fittings. ‖ Including £8946 paid to pension, &c., funds, and £23,028 paid under profit-sharing scheme.

TABLE *showing the Capital, Income, Expenditure, and Profit, per Ton of Coal Carbonized (including Oil), in* 1899.

| — | Chartered. | Commercial. | South Metropolitan. | All the Companies. |
|---|---|---|---|---|
| | £ s. d. | £ s. d. | £ s. d. | £ s. d. |
| Capital and borrowed money | 12 11 7·37 | 4 8 10·08 | 7 7 10·07 | 10 8 5·90 |
| Income—viz.: | | | | |
| Total gas-rental | 1 9 7·00 | 1 6 10·83 | 19 8·97 | 1 6 4·45 |
| Rental of meters and stoves | 4·87 | 1 2·36 | 1 2·39 | 8·46 |
| Residual products | 8 6·39 | 6 10·89 | 8 10·14 | 8 6·21 |
| Miscellaneous, including old materials | 1·89 | 0·79 | 1·75 | 1·77 |
| Total income from all sources | 1 18 8·15 | 1 15 0·87 | 1 9 11·25 | 1 15 8·89 |
| Expenditure—viz.: | | | | |
| Coal and oil, including carriage and dues | 13 0·86 | 13 9·40 | 11 9·91 | 12 8·84 |
| Purifying materials, including labour | 7·78 | 1 1·99 | 7·05 | 7·98 |
| Salaries and wages—manufacture | 3 6·96 | 3 4·50 | 2 5·04 | 3 2·51 |
| Wear and tear—manufacture | 3 4·77 | 2 9·68 | 3 3·54 | 3 3·91 |
| Rents, rates, and taxes | 2 3·10 | 1 3·24 | 1 1·54 | 1 10·11 |
| Salaries—management | 2·52 | 2·49 | 1·08 | 2·08 |
| Collectors' salaries and commission | 4·54 | 4·02 | 3·86 | 4·29 |
| Stationery, printing, and general charges | 2·37 | 2·56 | 2·52 | 2·43 |
| Directors and auditors | 0·67 | 2·68 | 0·86 | 0·86 |
| Salaries and wages, wear and tear—distribution | 1 8·57 | 1 2·61 | 1 9·43 | 1 8·42 |
| Repair and renewal of meters and stoves, &c. | 11·74 | 10·81 | 10·44 | 11·28 |
| Law and parliamentary charges | 0·54 | 0·49 | 0·26 | 0·45 |
| Bad debts and extraordinary expenses | 5·13 | 4·05 | 8·09 | 5·97 |
| Total expenditure on revenue account | 1 6 11·55 | 1 5 10·52 | 1 3 3·62 | 1 5 9·13 |
| Gross profit | 11 8·60 | 9 2·35 | 6 7·63 | 9 11·76 |

TABLE *showing the Increase or Decrease in each Item during* 1899 *compared with* 1898.

| — | Chartered. | | Commercial. | | South Metropolitan. | | All the Companies. | |
|---|---|---|---|---|---|---|---|---|
| | Inc. | Dec. | Inc. | Dec. | Inc. | Dec. | Inc. | Dec. |
| | £ | £ | £ | £ | £ | £ | £ | £ |
| Capital and borrowed money | 14,014,215 | .. | 10,313 | .. | 119,645 | .. | 14,144,173 | .. |
| Income—viz.: | | | | | | | | |
| Sale of gas by meter | 123,100 | .. | 15,423 | .. | 21,177 | .. | 169,700 | .. |
| Public lighting, including lighting under contracts | .. | 4,626 | .. | 172 | .. | 2,801 | .. | 7,599 |
| Rental of meters and stoves | 7,484 | .. | 1,865 | .. | 1,587 | .. | 10,937 | .. |
| Residual products | 193,341 | .. | 9,688 | .. | 119,879 | .. | 322,908 | .. |
| Miscellaneous, including old materials | 1,316 | .. | .. | 430 | 854 | .. | 1,740 | .. |
| Total income from all sources | 330,615 | .. | 26,374 | .. | 140,696 | .. | 497,686 | .. |
| Expenditure—viz.: | | | | | | | | |
| Coal and oil, including carriage and dues | 164,104 | .. | 17,375 | .. | 112,084 | .. | 293,463 | .. |
| Purifying materials, including labour | .. | 1,999 | 3,743 | .. | 4,966 | .. | 6,710 | .. |
| Salaries and wages—manufacture | 747 | .. | 496 | .. | 7,147 | .. | 8,391 | .. |
| Wear and tear—manufacture | 60,019 | .. | .. | 3,315 | 11,794 | .. | 68,497 | .. |
| Rents, rates, and taxes | 12,633 | .. | 837 | .. | 1,451 | .. | 14,921 | .. |
| Salaries—management | 1,626 | .. | 201 | .. | 292 | .. | 2,119 | .. |
| Collectors' salaries and commission | 1,516 | .. | 263 | .. | 403 | .. | 2,182 | .. |
| Stationery, printing, and general charges | 95 | .. | 347 | .. | 1,244 | .. | 1,686 | .. |
| Directors and auditors | 82 | .. | .. | .. | 105 | .. | 187 | .. |
| Salaries and wages, wear and tear—distribution | .. | 6,333 | .. | 151 | 17,828 | .. | 11,343 | .. |
| Repair and renewal of meters and stoves, &c. | 857 | .. | 1,318 | .. | 7,104 | .. | 9,279 | .. |
| Law and parliamentary charges | .. | 845 | 206 | .. | 753 | .. | 115 | .. |
| Bad debts and extraordinary expenses | 4,230 | .. | 2,445 | .. | 2,537 | .. | 9,212 | .. |
| Total expenditure on revenue account | 236,732 | .. | 23,665 | .. | 167,708 | .. | 428,105 | .. |
| Gross profit | 93,883 | .. | 2,709 | .. | .. | 27,012 | 69,581 | .. |
| Do. per cent. on capital and borrowed money | .. | £4 5s. 3d. | £0 3s. 2d. | .. | .. | £0 8s. 5d. | .. | £2 15s. 6d. |
| Do. do. gas-rental | £1 8s. 1d. | .. | .. | £0 16s. 5d. | .. | 3 4 4 | £0 3s. 8d. | .. |

## PERSONAL.

Mr. JAMES GEMMELL, late of Dreghorn, has been appointed Manager of the Melrose Gas Company, in succession to Mr. W. Smith, resigned.

Mr. JOHN GIBB, of Lanark, has been appointed Manager of the Kirkintilloch Corporation gas undertaking, in succession to Mr. D. Jeffrey, resigned.

Mr. JOHN AIRD, M.P. for North Paddington, replying to a deputation last Wednesday, signified his willingness to be nominated as first Mayor of Paddington.

The position of Referee for ascertaining the rainfall in the Derwent Valley for compensation purposes, vacant by the death of Mr. G. J. Symons, has been conferred upon Dr. BARWISE, Medical Officer of Health for Derbyshire.

The Directors of the Canterbury Gas and Water Company have appointed Mr. HARRY C. PAGE, of Leigh (Lancs.), Manager of the gas-works, in succession to Mr. T. May, whose resignation was announced in the "JOURNAL" a few weeks ago.

A report recently reached us to the effect that Mr. CHARLES TAYLOR, the Engineer of the Derby Gas Company, and Mr. RICHARD FISHER, the Secretary, will retire at the close of the present quarter. This rumour has in part been confirmed by the announcement which appears in another page of the "JOURNAL" of the desire on the part of the Directors to receive applications or the position to be vacated by Mr. Taylor.

At the last meeting of the Directors of the Formby Gas Company, Mr. JOHN HOWGATE BUCKLEY was unanimously appointed Engineer and Manager, in succession to his father, whose death was recently recorded in the "JOURNAL." Mr. Buckley has been for fourteen years in the Company's service, and for some time filled the position of Assistant-Manager. At the same meeting, a vote of condolence was passed with the widow and family of the late Manager.

## NOTES.

### The Durability of Paints and Varnishes.

Professor A. H. Sabin has published the results of an extensive series of experiments on protective paints for ironwork, carried out for the United States Navy Department. The preparation of the test plates was of an elaborate character; a vast variety of pigments and varnishes were used; and the tests, carried out under natural conditions of exposure to air and water, were very severe. All the plates had three coats of paint, well dried between the coats. In most cases deterioration appeared to begin on the surface, which becomes rough. Then little blisters appear, which are caused by the separation of the last coat from those beneath. Finally, the undercoat blisters, in which case it is found almost invariably that rust has formed under the blister. If, however, the paint coating is porous, which seems to be the case with ordinary oil paints, the water reaches the metal and causes rust. This throws off the paint film, and the corrosion rapidly spreads. Red lead in oil differs from both paints and varnishes in being a cement. Ordinary oil paints perished wholly, irrespective of the nature of the pigment or filling employed. Varnishes appeared to stand best, especially the more elastic preparations. Shellac varnish is strongly recommended for metal that is to be immersed in fresh water; but it does not stand ammonia. The baked enamel known as "Sabine Pipe Coating" lasted remarkably well. A patented preparation called "Durable Metal Coating" is stated to have come out best of all.

### The Strength of Frozen Concrete.

The question of the action of frost upon portland cement concrete work is a highly important one for constructors. As the "Engineering Record" remarks, it is a commonly accepted opinion among engineers that the construction of concrete masonry, especially above ground during freezing weather, is bad practice, and should be avoided if possible. This would limit concrete work over a great part of North America to the months of April to October inclusive; but necessity has dictated the carrying on of many such works during the winter months. There has still, however, been a great uncertainty as to the effect of freezing upon unset concrete; and Mr. W. A. Rogers, Assistant-Engineer to the Chicago, Milwaukee, and St. Paul Railway, set himself to ascertain the truth of this matter by direct experiment. The details of the tests need not be given; suffice it to say that comparative trials were made with protected and exposed concrete blocks during an exceptionally cold winter. The results went to show that freezing before setting does not seem to injure portland cement concrete, even if, after having frozen hard, the concrete is exposed to alternate freezing and thawing weather. Exposing green portland cement concrete to a freezing temperature seems to affect its rate of hardening, making it slower; but eventually the concrete will be just as good as if it had not been exposed to the cold. The use of salt water seems to counteract the effect of cold in delaying the hardening. A strong example in point was that of an anchor-block for a 100 ton shear-leg crane, which was made during a hard frost. A double-handful of salt was added to every pail of water used in gauging the concrete; and after six months the concrete was found to be perfectly sound and hard.

### The Use of Conveyors in Excavating.

An ingenious use of the belt conveyor is reported in the "Engineering Record" in connection with the excavation of the site of the new 120,000-horse power supply station of the New York Gas, Electric Light, Heat, and Power Company. The whole area of the site, which is on the riverside, is being dug out to a maximum depth of 19 feet. It is chiefly made-ground; there being 25,000 cubic yards of earth and 9000 yards of rock to remove. Work was begun by digging a trench 7 feet wide perpendicularly to the river bank, where the barges lay, and extending three-fourths of the way across the site. In this trench was placed a belt conveyor which delivered the spoil thrown upon it to the tips. The main belt runs at a speed of 350 feet per minute, and has an estimated carrying power of 300 cubic yards an hour. It is spanned by three wooden bridges, which carry the spoil to the belt, and drop it through hoppers. All the spoil found on the site is transported in this way, excepting only big blocks of masonry removed from old foundations. The loose stuff is simply scraped up by horse scrapers which go round and round, finally dropping their load into the hoppers. A force of about 75 men, with two ploughs and twelve wheel scrapers, removed about 1200 cubic yards of rubbish in 9½ hours, all of which was easily dealt with by the conveyor at the cost of the boiler fuel and one man. When the excavation is finished, the same conveyor will be used to carry the concrete from the mixers to the footings of the walls and machines. The whole outfit is rigged with timber framework, and the conveyor is driven by a 9 inch by 12 inch engine.

### Treating Coal for Coking.

Herr Schild, of Bochum, has continued the study of coking and non-coking coals, with the object of ascertaining the reason for this difference. He now states that coals which form a cake, as well as coke, can be deprived of most of the former quality by long continued washing, or, better still, boiling, in a large quantity of water containing chloride of magnesium. After enough of this treatment, the coals will still coke, but scarcely cake at all. If the wash-water is evaporated, a residuum is obtained which, when added in dust form to the badly-coking coal, almost completely restores this property. The result may be made to improve upon the original performance, if what is washed out of a large quantity of coal is added to a smaller quantity. Nothing is stated respecting the character or composition of this extract of caking oil; but it is said that a substance possessing the same property is lignin, which is a waste residual of the process of preparing sulphite cellulose. Whether a coal can be made to coke well by adding this lye can only be determined by trial. Many considerations of time, quantity of materials, degree of dampness, &c., go to the success of such experiments. Some poor coals will not coke simply because they do not yield gas enough to burn with the oxygen of the air occurring in the mass of the charger; others because they are too rich, and the oxygen burns off the surfaces of the particles into ash, thus preventing agglomeration. Herr Schild is careful to state that nothing but tests on a working scale will show the capacity of a coal (treated for the purpose or not) to make good coke. The subject is of national importance, as much German coal will not coke by itself; and to blend coals for the purpose is not often commercially practicable.

**The German Benzine Association** (an organization which has been formed for the purpose of fighting certain Continental refiners), it is reported, now commands an annual production of 35,000,000 kilos. of material.

**Labour-Saving Methods in Gas-Works.**—In the number of the "Engineering Times" for the current month, Mr. C. E. Brackenbury commences a series of illustrated articles on "Modern Methods of Saving Labour in Gas-Works." In the editorial notice of the articles (which is accompanied by a portrait of Murdoch, reproduced from an old steel engraving), it is stated that Mr. Brackenbury will also deal with the manufacture of water gas.

**The Effect of Low Temperatures on Coal Gas.**—Towards the close of his interesting address on "The Solidification of Hydrogen," at the Royal Institution on the 6th inst., Professor Dewar showed the effect of low temperatures upon coal gas. He demonstrated by experiment the difference observable in the luminosity of gas when burnt under four conditions—as it came from the mains, and after it had passed over solid carbonic acid, liquid air, and liquid hydrogen. In the last case, the luminosity was practically *nil*.

**Steel Production in the United States.**—The last few years have witnessed a great increase in the production of Bessemer steel in the United States. In 1896, the tonnage of ingots was 3,919,906, and of rails 1,102,892; whereas for last year the figures were 7,586,354 and 2,240,767 respectively. The "Financial News" thinks that these are the sort of figures to bear in mind when British manufacturers get behind in their orders, and let other orders pass because they are full of work. American manufacturers, our contemporary points out, extend their production in like circumstances.

## COMMUNICATED ARTICLE.

### THE FUTURE OF WATER GAS IN FRANCE.

By Just Alix, Chemist to the Lyons Gas Company.

The facility with which the public are now able to provide themselves with an ample supply of light at a cheap rate, owing to the competition set up between the various systems of illumination, has produced in the gas industry a kind of revolution—a perfectly peaceful one, it is true—out of which, with a certain amount of effort, it will no doubt emerge triumphant, and then become more prosperous and more flourishing than before. The economical explanation of this state of things is a very simple one. It is to be found in a similar set of circumstances to those which have presented themselves at various epochs sufficiently near our own times for our recollection of them to be very clear. There is occurring at the present day, in connection with the gas industry, just what happened to the colouring matter industry fifty years ago, when artificial materials made their appearance; and also to tanning, upon the introduction of more rapid methods of working than those previously in use. Why has the turn of the gas industry to be affected been so long delayed? Because the conditions under which illuminating gas is produced have protected it from the disturbing effects which other industries experience from free competition and the introduction of new and more economical processes.

The future which has been opened before us by existing circumstances is not a particularly bright one. It will be a time of increased work and keener competition; but will there be any insurmountable difficulty? When one is well armed, there is more certainty of the successful issue of a struggle; and do not we gas people possess in the irreproachable past a solid pedestal for the future? Up to within the past few years, the gas industry has been supported by the distillation—more or less perfect, but always sufficient for its requirements—of coal. By this process we obtain from (say) 100 kilos. of carbon about 30 cubic metres, or 1000 cubic feet, of utilizable gas, containing from 4 to 5 per cent. of light-giving hydrocarbons and 70 per cent. by weight of almost pure carbon, as shown by the following figures, obtained with a gas of average quality:—

| | | | Per Cent. |
|---|---|---|---|
| Coke— | | | |
| 70 per cent., less 8 per cent. of ash = pure carbon | | | 62·00 |
| Gas— | | | |
| Illum. hydrocarbons ($C_2H_5$), containing of carbon. | | 1·608 kilos. | |
| Methane ($CH_4$) | ,, ,, | 6·435 ,, | |
| Carbon monoxide (CO) | ,, ,, | 1·284 ,, | |
| Carbon dioxide ($CO_2$) | ,, ,, | 0·153 ,, | |
| | | | 9·48 |
| By difference (tar and volatile bodies) | | | 28·52 |
| | | | 100·00 |

We have therefore in the coke 62 per cent. of carbon; in the gas, 9·48 per cent.; and in the tar and volatile bodies, 28·52 per cent. These proportions may perhaps be more easily appreciated when shown diagrammatically, as in fig. 1, in which the dark shading represents the carbon in the gas, the light shading on the left that in the coke, and the right-hand shading that in the tar.

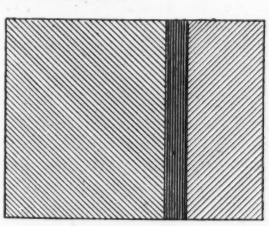


Fig. 1.

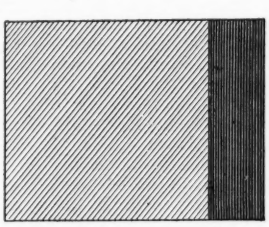


Fig. 2.

From the calorific point of view, the comparison is equally striking between the caloric utilized in the form of gas and that which remains in the coke and tar. A sample of Commentry coal had the following percentage composition: C, 82·72; H, 5·29; O and N, 11·75; and ash, 0·24; and it had also an average calorific power of 7200 heat-units—its heat of combustion being 5100 calories per cubic metre. Now, 1 kilo. of coal yields 300 litres (10·6 cubic feet) of gas possessing a heating value of 1530 calories. Consequently, 5670 calories (7200—1530) remain in the coke and tar. We have therefore 21·25 per cent. of caloric in the gas, and 78·75 per cent. in the coke and tar. Represented diagrammatically, the proportions stand as fig. 2; the dark shading showing the caloric in the form of gas.

The foregoing figures show that we coal-gas makers obtain with our methods of distillation a more than mediocre yield of gasified carbon, especially in an epoch in which the progress of science permits of the easiest utilization of what we must call our "bye-products"—coke, tar, &c.—under the penalty of losing our qualification as gas men.

It is this that has prompted those who have been anxious in regard to the future of the gas industry to seek in a domain already known to them—that of mechanics—means of improving their methods of operation; hence the appearance of regenerative furnaces, inclined retorts, and retort charging and drawing machinery. At the same time, considerable attention has been given to appliances for effecting economy in handling the raw material, with the result that conveyors and elevators have been introduced. All these innovations—interesting, no doubt, in themselves, but often very costly—are signs of the fillip which has been given to the progress of the gas industry, and of the turn of mind which has directed this progress into the purely mechanical channel; because those who have guided it had been trained on these lines, and consequently have followed their tastes and aptitudes.

Notwithstanding the existence of these beautiful mechanical inventions, which have converted certain works into veritable models of precision, the vital question has again presented itself, and has turned the current of thought into a channel perhaps more scientific, but at the same time assuredly more chemical—namely, the more complete utilization of the raw material. Moreover, here is one fact which has affected the future of the gas industry in all countries, and that is the increasing poverty of coals in those constituents which make them valuable for gas-making purposes—viz., the light-giving hydrocarbons. As the seams of coal are worked into, and the mines increase in depth, the quantity of hydrocarbons found in the same class of coal decreases. This phenomenon, which has become very noticeable in connection with the smaller coal measures, threatens to attack the more important ones. Its explanation is to be found in circumstances which are of daily occurrence near us. I refer to the transformation of vegetable matter into peat, and of peat into lignite. Unfortunately, this change takes place also in the deep layers, under the influence of great pressure, in the case of coal, which tends to become of an anthracitic character, and to lose its small percentage of volatile hydrocarbonaceous products, which, as already stated, constitute its special value for gas makers.

But for every ill there is a remedy; and the gas industry has received very strong support from the invention of Dr. Auer von Welsbach, which, by the utilization of the carbon, employs to the greatest possible extent the energy stored up in the coal, and does so, moreover, in its true form—the calorific. In the struggle which the gas companies have to sustain with their numerous rivals—some of which, such as arc and incandescent electric lighting, are already powerful, while others, of more recent date, like petroleum, alcohol, benzol, and acetylene, are making progress as illuminants in circumstances favouring their economical application—Dr. Auer's invention has been a revelation which has resulted in a revolution, inasmuch as all the competitors previously cited have endeavoured to apply its principle to themselves. This has led, in the domain of electricity, to the production of the Nernst lamp; in that of gasified liquids, to the introduction of the Kitson system; and in that of acetylene, to the adaptation of incandescent mantles to lighting by means of this gas.

In face of such a condition of things, what remains for us to do? To enable us to carry on the struggle, there is only one weapon available, and that is water gas. It is by the introduction of the manufacture of this gas that we shall be able to utilize the whole of the caloric in the coal; and it is this fact which explains the universal success of the system at the commencement of the economic crisis in the gas industry. To those who know us, there is nothing surprising in the circumstance that we in France have been the last, or very nearly the last, to recognize this. It is one of the consequences of our temperament. And yet as long ago as the 12th of June, 1878, our distinguished chemist Würtz pointed out that the use of water gas had never been prohibited in France, and that if the process which had been originally devised for its production had been abandoned, or only adopted to a limited extent, this was principally due to technical and economical conditions which had up to that time been unfavourable to its production. Between 1834 and 1865, the towns of Dijon, Strasburg, and Narbonne, and the Royal Printing Office in Paris were successively lighted by water gas. Then the system was dropped, and the whole thing fell into oblivion. In the interval named, coal was to be had in abundance; and modern notions of introducing to an ever-increasing extent the physical and chemical sciences into industry in general had scarcely developed. But to-day we have in our hands a weapon the use of which promises us a brilliant future—viz., the more effective utilization of the caloric in our coal as the result of its more complete gasification.

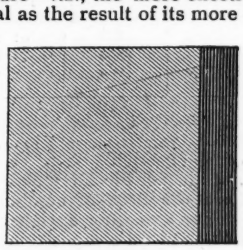


Fig. 3.

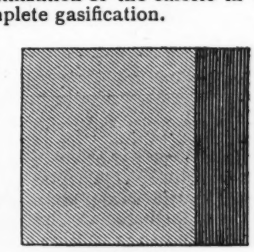


Fig. 4.

In this connection, let us see what figures have to tell us. We know that 100 kilos. of coal yield about 1000 cubic feet of gas, by the customary process of distillation. But by the addition to

our ordinary plant of apparatus for the production of water gas, we should get with our 100 kilos. of coal the above-named quantity of illuminating gas and 70 kilos. of coke, which, when gasified in accordance with the most recent processes, would yield 5000 cubic feet of gas; making a total of 6000 cubic feet of gas per 100 kilos. of coal. The effect is shown diagrammatically in fig. 3, in which the dark shading represents the product of this bulk of coal without water gas, and the light shading the result of its addition.

From the point of view of the quantity of caloric contained in the gas produced in the two cases, the comparison is equally interesting. In fact, in the first case we have—

| | Calories. |
|---|---|
| Coal gas alone | 149,350 |
| Coal and water gas (149,350 + 395,400*) | 542,750 |

These results are shown diagrammatically in fig. 4. The combustion temperatures of the two gases are—

| | |
|---|---|
| Coal gas | 2700° C.* = 4892° F. |
| Water gas | 2859° C.* = 5178° F. |

The preceding considerations therefore show us that, under favourable conditions, a gas-works in which coal is simply carbonized could produce six times as much gas by more completely utilizing the carbon which is thus so imperfectly dealt with. This enormous difference is well calculated to appeal to the most incredulous; and the eloquence of similar results pleads sufficiently in favour of the new cause.

From the practical point of view, when the question of the selection of a system has to be considered, the choice is not a very easy one; for, though the manufacture of water gas is in theory a simple process, its applications are multitudinous. The following table will give an idea of the results obtainable with a particular process and apparatus:—

*Analyses of Water Gas.*

| Name of Gas. | $CO_2$. | CO. | H. | $CH_4$. | N. | O. |
|---|---|---|---|---|---|---|
| Dowson | 6·00 | 23·00 | 17·00 | 2·00 | 52·00 | .. |
| Tessie du Motay (New York) | 0·21 | 26·18 | 27·29 | 25·43 | 4·45 | 0·14 |
| " " " | 3·10 | 25·20 | 28·30 | 26·60 | 1·20 | .. |
| Granger and Collins | 0·14 | 23·58 | 35·88 | 20·55 | 3·85 | 0·01 |
| " " | 0·30 | 28·26 | 37·20 | 18·88 | 2·64 | 0·06 |
| White | .. | 14·86 | 47·39 | .. | 27·20 | .. |
| Leprince | 0·30 | 6·30 | 25·25 | .. | 58·41 | .. |
| Anthracite | 2·05 | 35·38 | 52·76 | 4·11 | 4·43 | 0·77 |
| New York | 0·10 | 29·40 | 38·05 | 11·85 | 3·71 | 0·10 |
| Lowe | .. | 29·20 | 22·60 | 31·90 | 2·30 | 0·80 |
| " | 3·80 | 25·70 | 31·80 | 20·80 | 4·20 | .. |
| " | 3·30 | 18·30 | 28·10 | 21·70 | 3·50 | .. |
| " | 0·30 | 28·98 | 27·09 | 25·82 | 3·88 | 0·40 |
| Lewes | .. | 15·15 | 40·77 | 29·20 | 0·54 | 0·13 |
| Witkowitz | 1·00 | 46·00 | 48·00 | 0·50 | 4·50 | .. |
| " | 3·60 | 40·40 | 51·00 | 0·50 | 4·50 | .. |
| Essen | 3·30 | 44·00 | 48 60 | 0·40 | 3·70 | .. |
| " | 4·00 | 41·00 | 50·00 | .. | 5·00 | .. |
| Strache | 4·00 | 40·00 | 50·00 | 0·30 | 5·00 | 0·70 |
| Dellwik | 3·60 | 40·40 | 51·00 | 0·50 | 4·50 | .. |
| " | 3·60 | 40·40 | 51·00 | 0·50 | 4·50 | .. |
| " | 5·10 | 40·10 | 48·80 | 0·40 | 5·50 | 0·10 |
| " $CO_2 + H_2S$ | 5·20 | 40·70 | 47·80 | 0·70 | 5·60 | .. |
| " | 5·20 | 40·40 | 48·30 | 0·50 | 5·50 | 0·10 |

In the face of such divergent results as those here shown, one is probably embarrassed in making a selection. But, as a matter of fact, there are but few complications in the several systems named. All water-gas processes are really based upon only two principles: (1) The production of "blower" gas rich in carbonic oxide; (2) the production of gas rich in carbonic acid. In the first case, there is formed by the "blow" generator gas, which is afterwards burnt, with the addition of air, in recuperative chambers independent of the generator. In the appliances working on this system, we have, according to Dr. Bunte, the production of gas of the following composition at the temperatures specified:—

*Composition of Gas.*

| Temperature. | H. | CO. | $CO_2$. | Percentage of Vapour. | |
|---|---|---|---|---|---|
| | | | | Decomposed. | Intact. |
| 674° C. (1245° F.) | 65·2 | 4·9 | 29·8 | 8·8 | 91·2 |
| 758° C. (1396° F.) | 65·2 | 7·8 | 27·0 | 25·3 | 74·7 |
| 1125° C. (2057° F.) | 50·9 | 48·5 | 0·6 | 99·4 | 0·6 |

In good working, the quantity of carbonic acid cannot exceed 8 per cent. without the temperature falling too much to allow of the conversion of this gas into carbonic oxide being carried out with profit. The latter gas, produced by the "blow," is burnt in the fixing chamber, where the heat of combustion serves to so dissociate the petroleum, or any other enricher employed, that the resulting gas resembles in its composition that obtained by the distillation of coal, with the difference that the methane is replaced by a higher percentage of carbonic oxide, as shown in the following table, which has been prepared by Mr. E. Earnshaw, and published in a recent number of the "Journal of the Franklin Institute."

| Constituent. | Coal Gas. | Water Gas. |
|---|---|---|
| | Per Cent. | Per Cent. |
| Benzene | 0·50 | 0·60 |
| Heavy hydrocarbons | 4·25 | 12·80 |
| Carbonic oxide | 8·04 | 30·70 |
| Hydrogen | 47·04 | 32·40 |
| Methane | 36·02 | 13·90 |
| Carburets of a paraffin nature | .. | 2·40 |
| Carbonic acid | 1·60 | 2·70 |
| Oxygen | 0·39 | 0·70 |
| Nitrogen | 2·16 | 3·8 |
| | 100·00 | 100·00 |

(*To be continued.*)

* According to Naumann.

# TECHNICAL RECORD.

## THE MEETING OF THE INSTITUTION OF GAS ENGINEERS.

### Programme of the Proceedings.

We have received from the Secretary of the Institution (Mr. Thomas Cole) an advance copy of the programme of the forthcoming general meeting, which, as announced in the "Journal" for Feb. 6, will be opened at the Institution of Civil Engineers on the 1st prox., the President being Mr. J. W. Helps, M.Inst.C.E., of Croydon.

The proceedings on the first day will, as usual, commence with the presentation of the report and accounts, the election of members, the reception of the report of the Scrutineers, and the delivery of the Inaugural Address. A discussion will then take place on the subject of the suggested amalgamation of the Institution with the Gas Institute; and this will be followed by the reading of papers. Of these there are six: "The Adulteration of Coal Gas by Enrichment," by Mr. G. Livesey. "On the Calorific Power of Illuminating Gas," by Dr. H. G. Colman. "Inclined Retorts," by Mr. C. C. Carpenter. "Naphthalene in Coal Gas: Its Detection and Extraction," by Mr. Wilfred Irwin. "Notes on the Carbonization of Cannel and Shales for Gas-Making Purposes," by Mr. S. Glover. "Some Examples of Tank Construction," by Mr. Fletcher W. Stevenson. "An Experiment with a Concrete and Expanded Metal Structure," by Mr. A. Baker. In addition to the papers, there will be a lecture, on the morning of the second day of the meeting, by Professor Vivian B. Lewes, F.I.C., F.C.S., on "Water Gas and its Recent Continental Developments." The annual dinner will take place at the Café Royal, Regent Street, on the evening of the first day; and the third day will be devoted to a visit to the Royal Arsenal, Woolwich, where the following departments will be inspected (some "by special permission"): The main factory, the model-room, the bullet plant and shell foundry, the No. 1 small arm cartridge factory, the No. 1 quick-firing cartridge factory, the north boring-mill (with 40-ton hammer), the south boring-mill, the wheel factory, and the main machine-shop, &c. The party will lunch at the Royal Mortar Hotel, Woolwich, and in the afternoon will be conveyed in brakes to the Crystal Palace, where they will dine together in the evening.

The annual report of the Council, which accompanies the programme, testifies to a continuance of the prosperity of the Institution. Regret is expressed at the loss by death of Mr. Frank Livesey, Mr. G. Ernest Stevenson, and Mr. W. H. H. Broadberry—three of the original members, who took deep interest in the welfare of the Institution. Referring to the past year's proceedings, the Council remark that a prominent feature was undoubtedly the visit to Berlin and Copenhagen in September, which was greatly appreciated by all who attended it. They acknowledge that its success was largely due to the heartiness of the welcome extended to the members by the Berlin Municipality, the Directors of the Imperial Continental Gas Association, and by the German Gas Association, and also to the generous reception accorded to them by the authorities in Copenhagen, and the Directors of the Danish Gas Company, coupled with the kindly care, attention, and forethought of the President—Mr. F. D. Marshall. The works visited were full of interest; and their description will form no inconsiderable addition to the volume of Transactions for the year. On the subject of the suggested amalgamation, referred to above, the Council say: "In consequence of frequently expressed wishes that the advisability of amalgamating the two societies representing the gas industry should be considered, the Council were called together, and, after careful discussion, the opinion was unanimously expressed that such a course would be desirable. The Council of the Gas Institute having also arrived at the same conclusion, a Joint Committee was appointed, which, after holding several meetings, has drawn up a revised set of rules, to be now submitted to the members. Your Council propose, therefore, that the main principles shall be discussed at this meeting, and, in the event of the general feeling being favourable, that the matter should be adjourned to a special meeting to be held about the same time as that of the Gas Institute in June next,

when a resolution to dissolve would be submitted." An invitation having been received from the Société Technique du Gaz en France to take part in an International Congress to be held in Paris in September next, the Council, in accepting it, have nominated two of their number as corresponding members.

## WAVERLEY ASSOCIATION OF GAS MANAGERS.

### Half-Yearly Meeting at Selkirk.

The Seventy-Eighth Half-Yearly Meeting of the Association was held at the Station Hotel, Selkirk, last Thursday. There was a good attendance. Mr. W. B. M'Lusky, of Selkirk, the President, occupied the chair, and delivered the following

Opening Address.

Welcome, men of Waverley, to the ancient and royal burgh of Selkirk, so long associated in our minds with the name of William Robson, the originator of these meetings. The programme of proceedings promises us a drive to-day by the classic Yarrow, over the battle-ground of Philiphaugh, thence through the richly wooded estate of Bowhill, returning by the Vale of Ettrick. Amid such scenes as these, our thoughts will rise above the common daily round, dispelling business cares for the time being. The hour is twelve; let us turn our attention to labour, which maketh pleasure sweet.

At the conclusion of the remarks which I had the honour of addressing to you at our autumn meeting, I indicated that I would open for discussion to-day the question of supplying and fixing consumers' burners free. I also undertook to lay before you some particulars in regard to the cooker and coin-meter business at Selkirk. While these are topics second only in importance to proper conditions of manufacture and distribution, I feel confident it will not be necessary to treat the subject at length in order to provoke a general discussion. I will endeavour, therefore, to conform to the recognized rule of spring meetings, and give only a short address.

Every gas manager knows the value of a good gas-burner; but the question is whether we apply this knowledge in every-day practice to the benefit of our consumers, in reducing their gas bills or improving their light, or both. We have all learned at some time in our experience the value of a pair of 4-inch pliers and a good burner, as a ready and effective means of concluding an argument and establishing a lasting friendship with a consumer. Consumers will not be bored with statements of laboratory results showing 30-candle power gas, while they probably consume 6½ cubic feet per burner per hour, with a total light of 30 candles and a lighting value of 23 candles per 5 cubic feet. This is a typical case of the consumer with the big gas bill, who affirms that his light is no better than that of his neighbour who, as likely as not, has an equal amount of light for an expenditure of 5 cubic feet per hour. When the gas bill is big, the consumer invariably resorts to a smaller burner, which, if it is of an inferior sort, results in a consumption of 4½ to 5 cubic feet per hour, with a total light equal to 20 to 22 candles—an infinitely worse state of matters; for now "the gas is bad," and it is dear to boot.

From exhaustive tests with various burners with 31-candle gas, I have found a No. 4 enamel regulator burner, passing 5 cubic feet per hour at 17-10ths pressure, giving a light of 22-candle power, while an equal amount of light was obtained from an approved stuffed burner consuming 3·7 cubic feet at 10-10ths pressure. The path of duty is therefore plain. We, as gas managers, know the value of good burners, and we are aware of the absolute waste of money which attends the use of those of an inferior kind, or the indiscriminate use of those which are probably perfectly suitable in one zone of our distributing system but altogether unsuitable in another. Shall we, then, leave the consumer at the mercy of the itinerant dealer, who sells at 6½d. per burner, with the result that the gas is wasted and the painter is to pay for a special spring cleaning? Or shall we see to it that every consumer is provided with some suitable burners at the gas company's expense, regardless of what anyone may say against giving anything for nothing? The practice of supplying burners free to all consumers was adopted at Selkirk in the winter of 1897-98. The work is distributed over the collector-surveyor, the fitter, and his apprentice. We do not, however, encroach upon the trade connection established between large consumers and the local plumbers and gas-fitters. We supply the trade with gross lots of the burners free, marked for each district of supply. In this way, the right burner is fixed in the right place; and perfect harmony exists between the fitting trade, the consumers, and the Gas Company. In fact, we find that the local fitters push our burners. To the credit of the people of Selkirk be it said that they never for a moment viewed our action in this matter with suspicion; on the contrary, they have encouraged the scheme from the start. Consequently, our effort to improve the lighting of their homes and places of business has succeeded beyond my most sanguine expectation. As a matter of fact, the fixing of burners free has popularized the use of gas; and gas lighting has received a fresh impetus.

Any reference to burners which leaves out of account the illuminating power of the gas, can hardly be regarded as complete. For a number of years, but particularly during the past week, there has been a decided expression of opinion in favour of a reduction of the standard of light north of the Tweed; and it is satisfactory to find that cannel-coal Scotland has still a few champions of high-grade gas left, although it may be open to question whether the advocates of the high-grade article or the manufacturers of it are the more numerous. The present agitation for a reduction in the illuminating power is due to two things—viz., the abnormal advance in the price of coal on the one hand, and the great demand for clean, hard coke on the other. From a consumer's point of view, however, it is inopportune; for while we find, on comparing prices of really first-class cannels and splint coals, a difference of 10s. per ton at the pit, and about 9d. per 1000 cubic feet of gas made (having regard to the relative yield of each), in favour of splint, yet when we take into account the yield of illuminating matter per ton in each case, cannel is cheaper, light for light, by about 18 per cent.—the cost per candle per 1000 cubic feet being 0·76d. for cannel, and 0·90d. for splint. In our selection of the raw materials of manufacture, and in the conversion of the same into gas, our guiding principle must ever be the production of an article which will give the consumer the maximum lighting efficiency for his money. It may be necessary at some time to increase the illuminating power and the price—thus reducing the consumption and keeping the gas bill at about the same figure. And probably, at some very far distant date, it may be advantageous to reduce both the standard of light and the price. But in either case, the gas undertaking which supervises the fittings of consumers, and fixes burners free, will be in a position to provide effective gas lighting at moderate cost.

A brief reference to this subject will serve to show the important place now occupied in our returns by gas sold for cooking and heating purposes. A class of consumers who formerly used an average of 50,000 cubic feet of gas each per annum, without a cooker, now consume 71,000 cubic feet each. The part of this increase due to the introduction of the cooker is 21,000 cubic feet, or at the rate of 42 per cent. A class of consumers who, before the introduction of cookers, used 7000 cubic feet per annum, now reach 15,000 cubic feet. The increase from the cooker is 8000 cubic feet per annum, or at the rate of 111 per cent. Another class of consumers who formerly used 6000 cubic feet per annum, now attain the respectable figure of 17,000 cubic feet per annum. Here the increase per cooker is 11,000 cubic feet, or at the rate of 183 per cent.

Coming now to coin-meters, I find that our second year will account for a consumption of 676,000 cubic feet, against 508,000 cubic feet for the first complete year; being 168,000 cubic feet more—an increase equal to 33 per cent. Of 80 coin-meters fixed, 20 (or exactly 25 per cent. of the total) have cookers attached; the balance have boiling rings. An analysis of the accounts shows that the 20 cooker installations consume, on an average, 18,900 cubic feet per annum; whereas those without cookers consume an average of 4966 cubic feet each. Coin-meters with cookers attached are, therefore, worth practically 14,000 cubic feet per annum more than ordinary coin-meter installations. In other words, the 20 cooker installations give a return for the year of 378,000 cubic feet, and the 60 ordinary installations a return of 298,000 cubic feet.

*Discussion.*

Mr. W. Blair (Helensburgh) said that gas managers attempted to supply gas of a certain illuminating power; but unless they could educate their consumers in the burners which were suitable for the burning of the gas, it was immaterial what quality gas they supplied. In supplying burners free, a gas manager was doing the one thing which was, he thought, most essential for the making of gas popular. He had always advocated, and been allowed, to give burners free—using his own discretion in the matter. His object was to sell gas; and his practice always had been to advise consumers how to extract the greatest amount of duty from the gas, whether it was for cooking, heating, lighting, or motive purposes. There was some talk going on about a reduction of the illuminating power of the gas which they in Scotland had prided themselves upon supplying for, he might say, generations. He was afraid that in many places the reduction had already taken place. If they could, by the introduction of suitable appliances—burners and other things—give the consumer as much light from a low illuminating power gas as he was in the habit of getting from high-grade gas, he did not see why they should not try to push the introduction of such burners and appliances.

Mr. A. Bell, sen., (Dalkeith) thought gas managers should see to the fittings as well as the burners. In many towns anything was supposed to be good enough in the way of fittings. If they were to reduce the illuminating power of the gas, would the fittings be sufficient to supply it? He was afraid a great deal of grumbling and complaint would follow. People would not go in for the refitting of their houses; they would simply complain of bad gas. But if they could get the houses refitted, it would be different. In England, the poorer class of houses had not been fitted for gas consumption hitherto, as they had been in Scotland for many years; and the English people were now fitting upon proper lines. The probability was that in Scotland they would have to refit. Another question was, Were their works capable of supplying the low-quality of gas? If they reduced the illuminating power, all their mains would have to be renewed; because, most assuredly, people would have to burn more gas to obtain the illumination they required. Their plant was not suited for this; and there would be a great upturn in the works,

which would mean a great deal, although it was not a thing which would be done just in a moment. The supply of burners, in his opinion, was a necessary thing. He thought they were quite entitled to show people how to burn gas. There were plenty of good burners in the market; and their cost was small. The subject of meter-unions was spoken of at the Informal Meeting of Managers the previous week. This was a point he was especially strong upon; because he was officially connected with it all through the movement. He saw it commented upon that they had not taken advantage of it. It was the members of the North British Association who had really passed from it. After the Committee of the Association had carried the matter through, the members appointed them further to try to take the English Associations with them. He, for one, was always against that; because he thought it would swamp the matter, and this had proved to be the case. He could never see, either, why the Board of Trade should be consulted in the matter. The measuring part of the instrument was under the control of the Board of Trade; but he thought it was superfluous for them to seek the sanction of the Board of Trade for the couplings. The gas-meter makers said: "Adopt your standards; and the moment you become unanimous upon them, we will adopt them." And they did so; and paid for them. The couplings were theirs now. Gas managers had never taken advantage of them; they had never gone forward as a body with the movement, after having adopted the standards, so that it lay entirely in the hands of gas managers individually. He thought they should again go into the matter, and re-open it. He was confident that if they did so, the English Associations would fall in.

Mr. G. Taylor (Jedburgh) did not see how a reduced illuminating power gas would suit where they had not the best fittings. He did not think it would be any better for consumers, because they would burn more gas. He thought the keeping up of the standard, so long as they could get the coal, was better.

Mr. W. Young (Penicuik) said that since he went to Penicuik—now about two years ago—he had introduced somewhere about 100 prepayment gas-meters. There were altogether about 150 in use; and he found that they were a grand affair. There were consumers whom it formerly took him about six months to collect 3s. 6d. from, and from whom he now got 10s. or 15s.; and they said: "Why did you not introduce these prepayment meters long before?" In his last collection, in March, he had about £55 in coppers—somewhere about 2½ cwt.

Mr. D. Macfie (Edinburgh) said the President, in his very interesting address, emphasized two points—the illuminating power of the gas, and the supply of burners free. There were, of course, differences of opinion upon the subject of high or low illuminating power gas; but the question was coming to the front, and must be faced. As a gas consumer, he preferred high illuminating power; and he thought that in Scotland they had been used to a quality of gas which consumers had appreciated. A question had been raised as to the illuminating power of the gas which was now being supplied throughout Scotland. It had been delicately touched upon by Mr. Blair; and he thought that everyone would like to know authoritatively what was the average quality supplied in Scotland. The time was when the illuminating power was 28 or 30 candles. He did not suppose that anyone would claim that it reached that average to-day; but he thought it would be a charitable assumption to suppose that 25 candles would be a very good average as to what was being supplied. But there was a statement made over two years ago, in print, by a well-known burner maker, to the effect that, owing to the assimilation of the lighting power of Scotch cannel gas to gases in general use throughout the world, there was no longer any necessity of specially numbering burners for use with Scotch gas. This was a challenge thrown down; and no one took it up. He (Mr. Macfie) had never heard any gas manager controvert the statement. The statement amounted to this—that Scotch gas was of from 16 to 20 candle power; and this, he thought, was a large assumption. He would like to endorse the view of the President that gas companies ought to supply burners suited to the gas they manufactured. He should say that in every case where a reduction of illuminating power was carried out, it should be made perfectly well known to the consumers, and all the burners in use should be changed at the gas company's expense. He did not think he ought to touch upon the question of meter-unions (it was getting rather hackneyed); but he might say, without breach of confidence, that the subject had not been lost sight of, and that it might be settled sooner than some supposed.

Mr. A. Bell said he never heard of a burner maker altering the numbering of his burners—he neither saw it in print nor heard of it. It was not the case that gas in Scotland had been reduced to from 16 to 20 candles.

Mr. L. Bell (Innerleithen) thought it would be against the interests of gas companies and consumers that they should reduce the illuminating power of their gas. If they reduced the gas from 25 to 20 candles, it would be a reduction of 20 per cent. in illuminating power; and the price would not be reduced more than 5d. per 1000 cubic feet. But to get the same amount of light from 20-candle gas as from 25-candle gas, the consumer would require to use from 30 to 40 per cent. more gas. In such a case, he thought, the company would be giving the consumer gas for 5d. less, and be pocketing, possibly, 1s. by the reduction. He had found that burners made for English gas would not do for Scotch gas at all; he got only a blue flame with them. In the case of incandescent burners, with high-quality gas, he had to shut up the orifice about half. It was the same with gas-stoves. Some makers sent out gas-cookers which were quite unsuited for Scotch gas. He had introduced slot meters, and he found that he had about 50 per cent. more gas consumed through them than he had without them.

Mr. J. M'Laren (Duns) had always endeavoured to supply consumers with burners free; and the companies he had served had always been very good in giving him every allowance in the matter. As to keeping up the illuminating power, they must know that Duns was a very old place, and the fittings were about as old. If they were to reduce the illuminating power of their gas, they would require to refit about one-half of the town, at their own expense. He thought it would be a mistake for them to do that.

Mr. A. C. Young (Kelso) said in Kelso they would require 1s. 0½d. per 1000 cubic feet added to the price of gas to cover the extra cost of coal. This was a very serious matter; and he did not see how a reduction of 5 candles in the illuminating power of the gas was to answer, to cover even that, because if they reduced the gas from 25 to 20 candles they should reduce the price from 4s. 2d. to about 2s. 6d. But he thought that a reduction of about 2 candles might easily be made, even with existing fittings, if they paid careful attention to complaints. As to the difference between Scotch and English burners, if they were burning 5 cubic feet of gas per hour, with a fair pressure and a given quality of gas, they might have 10 candles illuminating power. With double the gas they would not get 20 candles, but perhaps 40 candles; because, by using a small quantity of gas, there was a tremendous loss of illuminating power, by reason of the atmosphere absorbing the heat of the hydrogen which otherwise would be utilized in keeping up the hydrocarbons to a luminous point. They had, however, to consider the large number of incandescent burners used, and also of cookers, now fixed; and he was afraid that if they had to increase the price of the gas very much, it would frighten those who were using gas-cookers.

Mr. F. Carlow (Lasswade) thought that, if they reduced the illuminating power, they would require to reduce the price of gas also. If they could get the particulars of how much gas was used in gas engines, cookers, and fires, he thought it would help them to come to a decision as to what to do.

Mr. W. M'Giffin (Earlston) supposed that he would be the Manager of about the smallest gas-works present. His pipes had been in use for about 75 years; and he had recommended his Directors, in the circumstances, rather than reduce the illuminating power of the gas, to reduce the dividend a little, and try to give gas at the same price for a year or two. He supplied burners free; and since he began to do so, the consumption of gas had risen about 25 per cent. He had 16 gas-cookers in use; and his summer consumption had increased about 300,000 cubic feet. He was supposed to give 27-candle gas; and he tried to honestly supply it.

Mr. A. Russell (Glasgow) said that in towns where there were a large number of mills to supply, if the illuminating power of the gas were reduced (at least too quickly), the mill-owners might introduce electric light, and thereby the gas consumption would be reduced very much. This was a thing which gas managers should consider, especially in the Borders, where they gave a very high illuminating power. The subject of coke had not been mentioned. He found that it had been advanced all round—in some of the larger works to the extent of from 2s. 6d. to 3s. per ton, which would help to compensate for the advanced price of coal.

The President, in concluding the discussion—alluding to a suggestion that in many cases splint instead of cannel coal might be used in making a change from high to low candle power gas—said splint coal would give 18 to 20 per cent. less light than cannel; and therefore a question which would have to be adjusted with the consumer would be whether he was to pay (say) 3s. 9d. or 3s. 1½d. The durability would be reduced along with the illuminating power, whether the consumer changed his burner or not. The reduction in the light would be in a greater ratio than the reduction in the illuminating power. A manufacturer, in considering how he was to operate for the year, took into account what his gas bill was to be; and if he found, at the end of the year, that his gas bill was up 20 per cent., he would simply adopt the electric light, no matter whether it was to be dearer or not. In Selkirk, there were five mills lighted by electricity; and there was a very free expression among them in favour of gas lighting. In the whole circumstances, he was of opinion that the quality of Scotch gas should be maintained. They had not only the manufacturer, but they had the poor man, in Selkirk. They had 1700 consumers, which was the largest proportion in Great Britain of consumers to the population. There were working men who were consuming 6000 cubic feet of gas per annum; and if they increased these people's bills to 7000 or 8000 cubic feet, he thought they would not be doing a fair thing. The reason why they had so many consumers was that they had always maintained the illuminating power of the gas. He had to be very cautious in the use of slot-meters, because the people in Selkirk were very respectable. The average amount of arrears was only 0·04 per cent. Therefore the slot-meter had come to be considered as only to be introduced where there were bad payers. He had about 90 slot-

meters in use at one time; but now he had only 80. People were sending them back. With regard to gas-stoves and incandescent burners, he found that the calorific power of the gas increased with the illuminating power—not, perhaps, in the same ratio, but near enough to warrant them in maintaining a high standard of illuminating power gas for stoves.

Mr. A. BELL mentioned that there were in Peebles 900 consumers of gas and 600 gas-cookers in use, which was altogether an exceptional case.

OTHER BUSINESS.

Mr. M'LAREN moved that Mr. W. M'Giffin, of Earlston, be elected President for next year.

Mr. YOUNG seconded the motion, and it was agreed to.

The PRESIDENT proposed that Mr. A. C. Young, of Kelso, be re-elected Secretary.

Mr. M'LAREN seconded the resolution, and it was cordially agreed to.

Mr. M'LAREN presented Mr. M'Lusky with the President's Medal of the Association, which Mr. M'LUSKY, in a sentence, returned thanks for.

This brought the meeting to a close.

THE EXCURSION.

The members and friends dined together in the hotel—Mr. M'Giffin in the chair. After the dinner there was a drive to Philiphaugh, the residence of Mr. W. S. Steel—beautifully situated on the banks of the Yarrow. The weather broke down in the course of the outward journey, and the drive terminated under uncomfortable conditions. The company were entertained to tea in the mansion house, and were afterwards received by Mr. Steel in his Art Gallery. The music room, the museum, and the conservatory were visited, each of which contained treasures that were much admired. Before leaving the Art Gallery, Mr. Macfie, in the name of the Association, thanked Mr. Steel for his kindness and hospitality. On account of the unpropitious nature of the weather, the remaining portion of the drive, which included visits to the birthplace of Mungo Park, Newark Castle, and Bowhill (the latter one of the seats of the Duke of Buccleuch) was abandoned, and the party returned to Selkirk.

## THE DETERIORATION OF LEATHER BOOKBINDINGS.

### The Effects of Gas Combustion.

In the course of an interesting paper read by Mr. Douglas Cockerell, at a recent meeting of the Society of Arts, on "Leather for Bookbinding," he referred to the fact that the Council of the Society had decided to appoint a Committee to investigate the subject of the production and deterioration of this class of leather, and went on to deal with the question of the damage it sustains from various causes. He remarked that if the damage noticed in leather bindings were confined to isolated cases, or even to isolated libraries, it might be thought to be the result of some special circumstances or accident; but when it was found that a large proportion of the bindings in most libraries had perished, some common cause for the injury must be sought. Various theories had been advanced from time to time; and some of those generally accepted he briefly mentioned.

The author first considered the theories which assume the damage to have taken place after the books have been placed in the library—viz., that the injury is caused by damp, by excessive heat, or by fumes from the burning of coal gas. He said that damp, as far as he had been able to ascertain, was not nearly so injurious to leather as excessive dryness. In extreme cases, where books were kept in a confined, damp space where air could not freely circulate, the growth of mildew would be encouraged. Although this was undoubtedly injurious, it was not the bindings exposed to damp, but rather those exposed to excessive heat, that first showed serious damage. The soundest vegetable-tanned leather, when submitted in an oven, for even a short time, to a temperature exceeding 100° C., lost its flexibility and toughness. It appeared to be the case that long exposure to the lower, but still excessive, dry heat to which books are subject on the upper shelves of most libraries tended to the same result. On this account it was advisable to pay great attention to top ventilation in libraries; and where the source of heat was a system of pipes or hot air, to adopt means to prevent the air from becoming too dry. This heat theory would, he said, account for the damage, were it not that older bindings which had been exposed to the same conditions were often found comparatively uninjured side by side with those on which the leather was utterly rotten. It would therefore be necessary to look for the reason which had rendered these damaged bindings specially susceptible to the effects of heat.

From time to time, he said, chemists have been consulted, with the result that analysis showed that there was nearly always a quantity of free sulphuric acid present in the leathers which had perished. As sulphuric acid (becoming after a time sulphuric acid by absorption of oxygen from the air) is one of the substances given off when coal gas is burnt, the theory that the damage was caused by gas was arrived at. The following extract from the report of the conference of the Library Association, held at Birmingham in 1887, shows that the gas theory was not a new one at that time:—

> The time-worn theory of the effect of gas upon leather bindings was introduced by two or three speakers. Mr. J. C. Woodward announced that, on submitting some bindings to an analysis, he was surprised to find that they yielded sulphuric acid in the proportion of 12 per cent. (?) to the weight of the leather. Professor Tilden, of the Mason College of Science, said it was naturally the books on the upper and topmost shelves that suffered most. A film of moist exhalation from the fumes of gas settles slowly on the tops of the books, and, evaporating, leaves a deposit of sulphuric acid which gradually destroys both leather and paper. In order to secure the better preservation of books, and to nullify the ill-effects of gas, it is extremely desirable that more careful ventilation should be provided in libraries than is now commonly the case.

It is no wonder that this theory was eagerly accepted by everybody concerned, as it absolved them all from blame. When complaints were made to the bookbinder of the decay of the leather, he escaped all responsibility by blaming the gas; and the manufacturers did the same. It was nobody's fault—a sort of law of Nature, which is hard, but must be put up with. Librarians seemed to say: "We must have books, and we must have gas; and if the two do not go together, it is clearly not our fault." So nothing was done. Unfortunately for this comfortable theory, it was found that the early decay of binding, and the presence of sulphuric acid in the leather, were not peculiar to libraries in which gas was used. At a meeting of our Committee,* Mr. W. J. Leighton showed a half-bound book in dark green hard-grained morocco, bound in 1883, which had been kept on a shelf without much use, the leather of which had rotted utterly. This he stated could not be the effect of gas, as there was only electric light in the library. Mr. Cyril Davenport stated that bindings in the British Museum showed similar decay, and that there they had neither gas nor electric light.

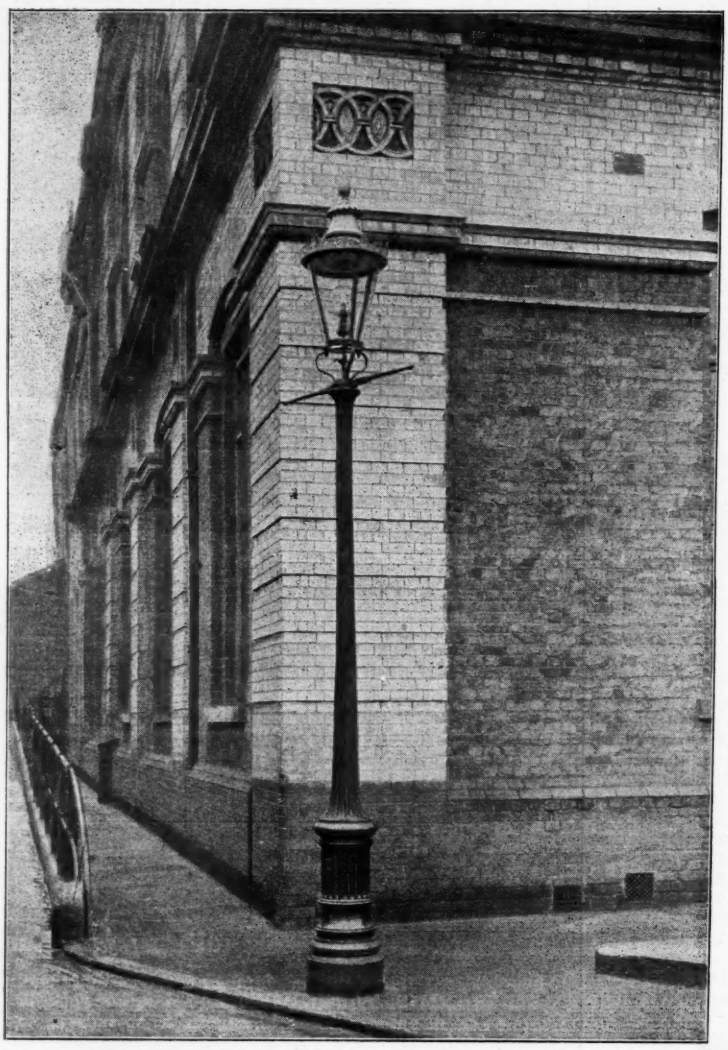
That the fumes of burnt gas are likely to be in some degree injurious to leather is admitted; and it is an additional reason for paying attention to the proper ventilation of libraries. But the evidence quoted seems to show conclusively that the gas theory will not account for all the damage, nor for the presence of sulphuric acid in leather not exposed to gas fumes. In June of last year, I submitted to an eminent firm of leather manufacturers samples of all the various leathers I was using for bookbinding, and their report was: "We have carefully tested and analyzed the sample pieces of leather collected from your place . . . . with the result that all, with the exception of the African leather, contain free sulphuric acid." Dr. Gordon-Parker, the Director of the Leathersellers' Company's Tanning School at Bermondsey, was also kind enough to test samples of various leathers; and I find on the minutes of our Committee's first meeting that "Dr. Parker stated that he had tested samples of Levant morocco submitted to him, and that they had not stood the tests as sound leather should." The samples were in both cases cut from leather I was using in my workshop at the time—leather of the most expensive sort to be got in London. . . . . As it appears from this evidence that sulphuric acid is present in the leather before it is used to cover books, it will be obvious that it is to the process of manufacture that we must look for its introduction.

In the course of the discussion which followed the reading of the paper, Mr. H. B. Wheatley, the Assistant-Secretary of the Society, remarked that the depreciation of bookbinding leathers had been a burning question for many years. The first occasion, he believed, on which any investigation was made was at the Athenæum Club in the forties, when Professor Faraday went into the matter very thoroughly, with the result that all the lamps in the club were provided with special chimneys to carry off the products of combustion; the idea then being that the chief source of mischief was the gas-burners. Further investigation, however, showed that it was probably not so much the gas itself as the heat from the gas—because the books at the United Service Club, where no gas was then used, were in an even worse state than those at the Athenæum. Hitherto it had been generally supposed that the deterioration of bindings was due to heat or bad treatment, which no doubt had much to do with it; but these dangers might be guarded against by ventilation and care. Mr. Walter Reid pointed out that if the books on the upper shelves of a library were found in a worse condition than those on the lower shelves, it did not at all follow that the difference was due to the heat. Wherever gas was used, the upper shelves were affected more than any other part. The watery vapour condensed on the books, which were at a lower temperature, and absorbed sulphurous acid. This by further oxidation became converted into sulphuric acid, which was found in the paper of the books as well as in the binding. Mr. Cockerell, in reply, said his chief authorities for attributing the damage in leather to sulphuric acid were Dr. Parker and Professor Procter. It was of the utmost importance that the investigation, whenever undertaken, should be thorough. It would occupy a long time; but no superficial examination would be of any use. The fact that for many years the damage to leather bookbindings had been attributed almost entirely to the use of gas, showed how dangerous it was to jump to a conclusion on insufficient evidence. He did not for a moment contend that gas was not injurious; and, of course, ventilation should be attended to. But leather went to pieces in libraries where no gas was used.

* A Committee formed at a meeting held at the Central School of Arts and Crafts, Regent Street, to "encourage the production of sound and durable leather for bookbinding."—ED. J.G.L.

## A MODEL STREET-LAMP COLUMN: INCANDESCENT LIGHTING IN SOUTH LONDON.

We have often in these pages lamented the difficulty of obtaining a really well-designed lamp-column—one which combined, without over-elaboration, artistic merit with utility. That difficulty was also felt not so long since by the South Metropolitan Gas Company in connection with their contracts for lighting the leading thoroughfares of South London with No. 4 Kern burners fitted in improved lanterns. It was thought a pity—and very rightly so—to mount the new lanterns on the existing old columns; and therefore steps were taken to get a suitable one. In the first place, a well-known architect was invited to assist the Company. He was told exactly what was wanted; and in due course he submitted a design. It was the most unsuitable thing that it is possible to conceive for the purpose. On a larger scale, it might have answered admirably as a monument in one of our public squares; but as a lamp column, it was altogether out of the



question. The services of another architect were requisitioned; and, although he entered thoroughly into the spirit of the thing, his idea of what constituted a fit and becoming lamp column was just as crude as that of his professional brother. His drawing followed very much on the same lines as the first one; and it depicted something which, brought into a corporeal state, would have done duty splendidly as a pedestal for a bust.

Outside aid failing, it was decided to see what could be done at home. Even the Chairman (Mr. George Livesey) turned his attention from matters of greater moment, and concentrated his thoughts for a time on this modest question of the design of a lamp column. Thinking over it from an engineer's point of view, it occurred to him that a lamp-post fashioned somewhat after the style of the Eddystone Lighthouse might meet general requirements and satisfy the most fastidious taste. The result proves that this was a happy thought. He set to work and designed the shaft of a column which is, as far as it is possible to adapt a column, on very much the same lines as the noted lighthouse—that is to say, as regards the curves, which is a distinct feature of the Eddystone. This so-called Eddystone shaft was reproduced on a small scale, a lamp was fitted to it, and then, in order to finish it off, it was placed on a base that harmonized in character with the rest of the design. Thus it comes about that engineering trained heads and hands have produced, without outside assistance, a column which has been generally approved by those responsible, from the Local Authority point of view, for the proper lighting of the roads. In other words, the Authorities have accepted the Company's design, and pronounced it a very good one. This judgment the accompanying photograph will enable most of our readers to endorse. The column is light in appearance, and graceful in form; and, with the improved lantern and incandescent burner, it will remove from those streets in which it is adopted the reproach which we have frequently cast on the hideous gas-lighting arrangements of our London streets. In this reformation of street lighting in South London, the South Metropolitan Company are treating the Authorities with the utmost liberality. They have agreed to give them, free of cost, as many of these columns as they require, and take back the old columns, with the proviso that when, from time to time, they may require to renew or increase the number of the old columns, the Company may be allowed to use the old stock.

Then with regard to the lanterns. They have been devised specially with the view of obviating shadows. A member of the Company's Board relates how, on one occasion when he was driving along the Embankment in a brougham, the horse prepared to jump, and did make a half jump, over a shadow thrown across the road by an ordinary lantern. To prevent occurrences of this kind, the new lantern has been made irregular in shape. The pane facing the road is very wide; it is, in fact, considerably more than one-third of the total circumference. The result is that the shadows thrown by the bars which support that pane very nearly, but not quite, coincide with the kerb-line; and therefore by the time the shadow gets into the part of the road that is used for traffic, it has almost vanished—there is not practically any shadow there.

At the present time, there are, in round figures, 14,000 incandescent street lamps in the Company's district—about 10,000 of them being No. 2 burners, 1800 No. 3, and the balance No. 4; and the number will continue to increase as the work of converting the lamps progresses. The whole of this change has been effected since the spring of last year, when the Company sent out their notification on the subject to the Vestries, which was referred to in our news columns at the time. The lamps are being fitted with Kern burners and Chalmers anti-vibrators. But the Company are really not pinned to any particular system; and if they can find anything better or more economical, they will adopt it. Of course, a great deal depends upon the production of a cheaper mantle in future, and whether it can be used with the Kern burners. However, if a cheaper and equally serviceable mantle were put on to the market, the Company would be quite prepared to discard all the Kern burners, in order to obtain the benefit of the less costly mantle; for the mantle is a continuous, and the most expensive, item in incandescent lighting.

A few words may profitably be added with respect to some special instances of interior incandescent lighting in the South London district. A fair number of public buildings have been fitted up by the Company with incandescent burners. The first, for which an annual charge is made including the cleaning and maintenance of the burners, has been the Camberwell Art Gallery. The large hall contains some good pictures; and the problem of lighting pictures is rather a difficult one. To obtain the best effect, the viewers should have the light screened from their eyes, and the pictures alone directly illuminated. This is the plan on which the Company carried out the work of lighting the hall; and the Curator describes it as being very successful. Since then the Company have fitted up the Camberwell Vestry Hall. This has a sort of double roof—a large glass screen forms a false roof, and above it is an ordinary glazed roof. The hall was formerly lighted by a large sun burner; but the Company, hearing the Vestry were contemplating an installation of electric light, decided to try the effect of improving the gas lighting. In consultation with the Surveyor, they determined upon placing above the glass screen (which is ground and figured) some 16 or 20 No. 4 Kern gas-burners, so that the whole of the light for the large Vestry hall passes through the screen. The result is all that could be desired. There is now a well-diffused, soft, and pleasant light throughout the whole hall; and there is no uncomfortable heating. On the contrary, the burners, from their situation, materially assist in the ventilation of the hall. They draw the vitiated air from below, utilize it, and pass it out through their own ventilating openings;

so that they really perform double service. There is rather a good sequel to this successful effort of the Company in combating the electric light. A short time since, the various Vestries in South London had a meeting in this hall to consider the question of opposing the Company's Bill in Parliament this session. Whatever the result of their conference on that particular subject may have been, in another direction it has had a beneficial effect so far as the Company are concerned. There was a oneness of admiration on the part of the delegates with the illumination of the hall; and it was conceded to be a remarkably good example of lighting. This gratifying piece of news the Company have heard from the Vestry Clerks as far separated as Battersea on the one side and Woolwich and Plumstead on the other. However destitute of all good principles and morality the Company may be in the eyes of the Vestries, they have demonstrated to them to the convincing point that they have one good quality—that they can, given the opportunity, illuminate a large establishment in a manner equal to, if not better than, any other system.

## MR. ALLEN'S RESEARCHES ON THE VAPOUR PRESSURE OF NAPHTHALENE.

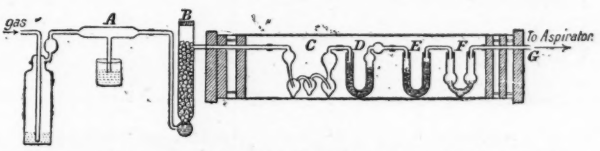
We gave in the "JOURNAL" for Sept. 5 last year a brief note concerning a paper on "The Maximum Pressure of Naphthalene Vapour," which Mr. R. W. Allen, M.A., had presented to the Chemical Society. We have since been able to publish the substance of a more recent paper by Mr. Allen (*ante*, p. 673), read before the Society of Chemical Industry, in which the author endeavoured to apply the results of his laboratory researches to the elucidation of the mysteries of naphthalene deposits in gas-mains. In view of the discussion which his latest paper has evoked in our "Correspondence" columns, readers will be glad to have further details of the parent paper, which is published opportunely in the April number of the "Journal of the Chemical Society." In the following abstract of the paper, we have dealt very briefly with those portions which were given at length in the subsequent paper (*ante*, p. 673). We have, also, for the sake of uniformity, stated quantities in grains in place of grammes, and temperatures on the Fahrenheit in place of the Centigrade scale.

A systematic study of the causes and means of prevention of naphthalene deposits in gas-mains demands an exact knowledge of the amount of naphthalene required to saturate a given volume of any gas at various temperatures, and consequently of the maximum pressure of naphthalene vapour at such temperatures. Naumann has determined the maximum vapour pressure of naphthalene to be: At 59° Fahr. = 2 mm., at 174° Fahr. = 9 mm., and at 212° Fahr. = 20·5 mm. These are the only measurements hitherto recorded; and they obviously only pretend to be approximations. The value given for 59° Fahr. is, on the face of it, improbable, since a substance having so high a vapour pressure would rapidly disappear on exposure, whereas naphthalene vanishes but slowly when freely exposed to the air. Ramsay and Young, in 1884, made some preliminary observations on the vapour pressure of naphthalene, at the time when they made measurements of the vapour pressures of benzene, acetic acid, and camphor; but they abandoned the research in so far as naphthalene was concerned—presumably because the method they employed was inapplicable in the case of that substance.

Owing to the fact that the vapour pressure of naphthalene at ordinary temperatures is very small, the usual system of measurement in the barometric vacuum appeared unsuitable. The evaporation method, which has been used in the case of liquids, seemed worth trial. It rests on the assumption that the vapour pressure of a volatile liquid in a space filled with an indifferent gas is very nearly equal to the vapour pressure in a vacuum. Regnault and Magnus have proved this assumption to be legitimate. A given volume of an indifferent gas at a definite temperature is passed over a weighed quantity of the volatile liquid (or naphthalene) of which the vapour pressure is to be measured; and the loss in weight of the liquid (or naphthalene) is estimated. This loss represents the weight—from which the volume may be calculated—of the vapour required to saturate the given volume of gas at the given temperature and pressure. Therefrom a simple calculation gives the value of the vapour pressure at that temperature. As the operation could be conducted slowly, and as the volume of gas to be employed was unlimited, the process seemed capable of a high degree of accuracy. It was therefore used in the first series of researches on naphthalene.

In the first place, pure naphthalene was prepared by digesting the commercial substance several times with sulphuric acid and caustic potash in turn, and washing with water after each treatment. The phenols and foreign hydrocarbons were thereby for the most part removed; and the purified sample was then thrice distilled with steam. Finally, it was drained, fused, powdered, and dried by exposure for several days in a bell jar over strong sulphuric acid. Its melting-point was then found to be 175·3° Fahr., and only a feeble pink colouration was produced by boiling it with strong sulphuric acid. It was therefore assumed to be pure.

Light U-tubes were then filled with the dried powder, and plugs of cotton wool were inserted, to prevent the powder being carried away mechanically. Dry corks, with glass tubulures, were cemented air-tight into the U-tubes. The water-bath and train of apparatus were substantially as shown. The bath had six air compartments running lengthwise through it, arranged in two tiers of three each; each compartment being 6 inches high and 4 inches wide. The water circulated freely round each compartment, and was well stirred by an agitator driven by water power. The temperature was controlled by a mercury thermostat, attached to a non-atmospheric burner. Holes were provided in the lid of the bath, for the rod of the agitator, the thermostat, and the thermometers which were graduated to tenths of a degree Centigrade. The temperature of the bath could be kept constant within 0·2° Fahr. for 24 hours. The gas passed through a wash-bottle to the safety-tube and pressure-gauge A; then




through the drying cylinder B, and bulbs C, charged with concentrated sulphuric acid. Thence the apparatus used was precisely as described in Mr. Allen's earlier paper—p. 673 of the "JOURNAL"—a calcium chloride drying-tube D; the U-tube charged with naphthalene, E; and a bulb F, charged with sulphuric acid, the outlet of which led to the aspirator G. The pressure and temperature of the atmosphere were observed at the conclusion of each experiment; and the volume of gas in the aspirator was corrected accordingly, and also for saturation by aqueous vapour. Thus the weight of naphthalene carried over in a given time by 1·271 cubic feet of gas, measured dry, and at 59° Fahr. and 760 mm. pressure, was found in all cases. The figures were, therefore, comparable. The ends of the air compartments of the bath were closed by triple layers of wood covered by flannel, with intermediate layers of cork. Air-currents were thus excluded; and the temperature of a compartment was precisely that of the water in the bath. In the first set of experiments, the temperature of the bath was exactly 86° Fahr.; and the gas was drawn through the tubes at various speeds, and the loss of weight of the naphthalene observed. Thence the weight of naphthalene corresponding to 1·271 cubic feet of dry gas at 59° Fahr. and 760 mm. was calculated, and the results recorded. Air, hydrogen, and coal gas were employed in turn in this set of experiments; but the last two gases were expelled from the tubes by air before weighing. The results are recorded in Table I.

TABLE I.

*Temperature 86° Fahr. Volume of Gas Employed = 1·271 cub. ft.*

| Gas Employed. | Length of Experiments. Hours. | Weight of Naphthalene Carried over. Grain. |
|---|---|---|
| Air | 2½ | ·4907 |
| ,, | 3¼ | ·4923 |
| ,, | 4 | ·4938 |
| ,, | 7 | ·4969 |
| ,, | 9¼ | ·5000 |
| ,, | 11 | ·5047 |
| ,, | 17 | ·5092 |
| ,, | 30 | ·5123 |
| ,, | 39 | ·5170 |
| ,, | 135 | ·5293 |
| Hydrogen | 1¼ | ·4815 |
| ,, | 4½ | ·4830 |
| ,, | 6¼ | ·4861 |
| ,, | 14 | ·5092 |
| ,, | 24 | ·5200 |
| ,, | 110 | ·5278 |
| Coal gas | 3 | ·4861 |
| ,, | 6 | ·4938 |
| ,, | 15 | ·4969 |
| ,, | 20 | ·5015 |
| ,, | 55 | ·5231 |

These results indicated that practically complete saturation of the gas was obtained in the slowest trials; but even in 24 and 30 hours, 97 per cent. of the saturation amount was obtained. It was decided to limit subsequent experiments at higher temperatures to about 24 hours, and add 3 per cent. to the observed values, in order to obtain the true saturation or "limit" value. Table II. [p. 1004] shows the results of several sets of experiments. In each case, correction was made for temperature, pressure, and the hygrometric state of the gas. The values given refer to 1·271 cubic feet of dry air or gas at 59° Fahr. and 760 mm. The limit value for 113° Fahr. was = (1·962 + 3 per cent.) = 2·021 grains; and for 140° Fahr. was = (6·968 + 3 per cent.) = 7·177 grains. The limit value for 167° Fahr. could not be found with certainty, as the experiments were limited to about three hours, owing to the difficulty of keeping the temperature of the bath constant for a longer period when so high a temperature was employed. If, however, the rate of increase in the naphthalene carried over corresponded with that observed at 140° Fahr., it would appear that the limit value for 167° Fahr. would be = 21·52 grains.

TABLE II.

*Temperature 113° Fahr.*

| Gas Employed. | Length of Experiment. Hours. | Weight of Naphthalene Carried over. Grains. |
|---|---|---|
| Air | 1½ | 1·840 |
| ,, | 2½ | 1·885 |
| ,, | 2¾ | 1·889 |
| ,, | 5 | 1·901 |
| ,, | 9 | 1·929 |
| ,, | 21 | 1·945 |
| Hydrogen | 1½ | 1·843 |
| ,, | 3 | 1·873 |
| ,, | 6 | 1·907 |
| ,, | 8½ | 1·932 |
| ,, | 24 | 1·962 |
| Coal gas | 2½ | 1·858 |
| ,, | 5 | 1·888 |
| ,, | 5 | 1·895 |
| ,, | 18 | 1·944 |
| ,, | 22 | 1·960 |
| *Temperature 140° Fahr.* | | |
| Air | 2½ | 5·840 |
| ,, | 5 | 6·188 |
| ,, | 15 | 6·941 |
| Hydrogen | 2 | 5·892 |
| ,, | 3½ | 6·130 |
| ,, | 4½ | 6·239 |
| ,, | 15 | 6·860 |
| ,, | 30 | 6·968 |
| Coal gas | 1¾ | 5·753 |
| ,, | 3¼ | 6·198 |
| ,, | 19 | 6·958 |
| *Temperature 59° Fahr.* | | |
| Air | 2½ | 0·2546 |
| ,, | 4 | 0·2562 |
| ,, | 10 | 0·2593 |
| ,, | 93 | 0·2623 |
| *Temperature 167° Fahr.* | | |
| Air | 2½ | 17·98 |
| ,, | 3 | 18·21 |
| ,, | 3½ | 18·38 |

From these limit values, the vapour pressure of the naphthalene was deduced according to Ostwald's formula—

$$p = \frac{62290\ g\ T}{m\ \ v}\ \text{mm.}$$

where g = the weight in grammes of naphthalene carried off; T = the absolute temperature of the room in degrees Centigrade (= 273 + 15° = 288°); $m$ = the molecular weight of naphthalene (= 128) and $v$ = 36,000 c.c. (= 1·271 cubic foot). The results are shown in Table III.

TABLE III.

| Temperature Deg. Fahr. | Limit Weight of Naphthalene Carried over. | Corresponding Vapour Pressure. |
|---|---|---|
| 59 | 0·2623 grains | 0·066 mm. |
| 86 | 0·5324 ,, | 0·135 ,, |
| 113 | 2·021 ,, | 0·51 ,, |
| 140 | 7·177 ,, | 1·81 ,, |
| 167 | 21·52 ,, | 5·43 ,, |

These values differed so considerably from those hitherto given for the vapour pressure of naphthalene, that an attempt was made to confirm them by the ordinary barometric method. Two glass tubes, § inch in diameter, and 3 feet long, were, after numerous trials, and with the exercise of special precautions, filled with mercury over a mercury-bath, so that, on inclining the tubes, residual air could with difficulty be distinguished. The height of the mercury in the two tubes was the same. A sealed glass bulb containing pure melted naphthalene was introduced into one of these barometer tubes; and after measurement of the depression due to a small quantity of air which was unavoidably introduced at the same time, the bulb was broken by heat, and the tube was inclined so that the naphthalene solidified at the top, where it did not interfere with the readings. The second barometer tube and thermometers were now lashed to this one; and the whole was exposed in a freezing mixture to a temperature of 0° Fahr. (at which temperature the vapour pressure of naphthalene was assumed to be *nil*), in order to ascertain if an additional small quantity of air had been inclosed in the bulb with the naphthalene. The depression due to the air introduced having thus been ascertained, the tubes were surrounded first with melting ice, then exposed to the air at 60·1° Fahr., and then in turn to the vapours of a number of substances of known boiling-point. The results thus obtained are given in Table IV.

TABLE IV.

| Temperature. | How Obtained. | Corresponding Vapour Pressure. |
|---|---|---|
| Deg. Fahr. | | |
| 32·0 | Melting ice | 0·01 mm. |
| 60·1 | Air | 0·08 ,, |
| 102·2 | Vapour of ether | 0·30 ,, |
| 116·2 | ,, ,, carbon bisulphide | 0·73 ,, |
| 143·2 | ,, ,, chloroform | 2·26 ,, |
| 173·1 | ,, ,, ethyl alcohol | 7·01 ,, |
| 176·7 | ,, ,, benzene | 7·54 ,, |
| 212·0 | ,, ,, water | 18·50 ,, |
| 240·8 | ,, ,, acetic acid | 36·87 ,, |
| 266·0 | ,, ,, isoamyl alcohol | 61·95 ,, |

The agreement between the values found and those found by the evaporation method, is very close, as may be seen from the accompanying curve. From such a curve, the maximum vapour pressures corresponding to every 5° C. or 9° Fahr. were deduced. These values are given below in Table V.

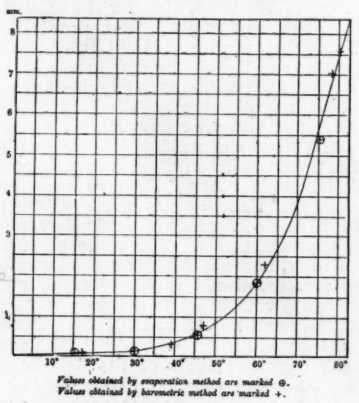
TABLE V.

*Maximum Vapour Pressures of Naphthalene.*

| Temperature. Fahr. | Corresponding Vapour Pressure. | Temperature. Fahr. | Corresponding Vapour Pressure. |
|---|---|---|---|
| 32° | 0·022 mm. | 158° | 3·95 mm. |
| 41 | 0·034 ,, | 167 | 5·43 ,, |
| 50 | 0·047 ,, | 176 | 7·4 ,, |
| 59 | 0·062 ,, | 185 | 9·8 ,, |
| 68 | 0·080 ,, | 194 | 12·6 ,, |
| 77 | 0·103 ,, | 203 | 15·5 ,, |
| 86 | 0·135 ,, | 212 | 18·5 ,, |
| 95 | 0·210 ,, | 221 | 22·4 ,, |
| 104 | 0·320 ,, | 230 | 27·3 ,, |
| 113 | 0·510 ,, | 239 | 32·4 ,, |
| 122 | 0·810 ,, | 248 | 40·2 ,, |
| 131 | 1·260 ,, | 257 | 49·8 ,, |
| 140 | 1·830 ,, | 266 | 61·9 ,, |
| 149 | 2·650 ,, | | |

This table forms the basis of the figures given in Table II. on p. 673 of the "JOURNAL."

*Curve of Vapour Pressures for Naphthalene.*




*Values obtained by evaporation method are marked ⊕.*
*Values obtained by barometric method are marked +.*

The author, in conclusion, draws attention to (1) the great advantages of the "evaporation method" in measurements of the low vapour pressure of solids at moderate temperatures; (2) the rate of evaporation of the naphthalene into the three gases hydrogen, air, and coal gas being the same, and therefore independent of the nature of the gas; and (3) the low vapour pressure of naphthalene as found in comparison with previously accepted values.

## VOLUMETRIC DETERMINATION OF SMALL QUANTITIES OF CARBON MONOXIDE.

The above subject has lately been dealt with, in the "Journal of the American Chemical Society," by Messrs. L. P. Kinnicutt and G. R. Sandford; and a summary of their results appears in the current number of the "Journal of the Society of Chemical Industry." After pointing out that air containing very small quantities of carbon monoxide may have an injurious effect if breathed for some time, the authors review the methods which have been proposed for the detection and estimation of this gas. Those based on the formation of carbon monoxyhæmoglobin are, in their opinion, only of value as qualitative tests; while of the various methods based on the oxidation of the carbon monoxide to carbon dioxide, they regard that in which iodine pentoxide is used as the oxidizing agent as the most satisfactory for the estimation of small quantities. Nicloux estimated the liberated iodine colorimetrically, and Gautier measured the quantity of $CO_2$ formed; but the authors have been unable to obtain accurate determinations of small amounts of CO by either method. They have, however, obtained good results by titrating the iodine with a N/1000 solution of sodium thiosulphate in the following manner: 25 grammes of iodine pentoxide were placed in a small U-tube which was suspended in an oil bath heated to 150° C. This tube was connected with a Wolff blood-absorption tube containing

0·5 gramme of potassium iodide dissolved in 5 c.c. of water. Its other limb was connected with two small U-tubes—one containing sulphuric acid, and the other fragments of potassium hydroxide; and the air passing through these was freed from all unsaturated hydrocarbons, hydrogen sulphide, sulphur dioxide, and other reducing gases, before coming into contact with the iodine pentoxide, which was prepared by the action of nitric acid on resublimed iodine, and after purification in the usual manner was freed from the last traces of iodine by being heated to 150° C. in a U-tube through which a current of air, freed from all reducing substances, was passed. In the authors' test determinations, the air (from 250 to 1000 c.c.) was mixed with known quantities of carbon monoxide, and passed through the apparatus at the rate of about a litre in two hours. The results, which are given in tabular form, are in close agreement with the theoretical amounts, and show that the method is capable of determining as little as 0·0025 per cent. by volume of carbon monoxide in air. It was also proved experimentally that the determination was not affected by the presence of the other constituents of coal gas; and the authors conclude from their results that if the presence of carbon monoxide in the air be due to a leakage of coal gas, and the amount of CO be known, an approximate estimation of the extent of the leakage may be obtained by their iodometric method.

## AUTOMATIC COAL-WEIGHING AND RECORDING MACHINES.

Gas companies obtaining supplies of coal by sea carriage not infrequently have trouble with the collieries over the question of the true weight of a cargo—more coal being reported to have been shipped than the weighing at the works records as delivered. The perfection of coal-weighing machinery (which is often uncertain in its results) is, therefore, to be desired.

That present methods are not always reliable or satisfactory, may be gathered from some remarks made by Mr. Charles Ingrey, M.Inst.C.E., in the course of a discussion upon a paper dealing with the subject, recently read by him to the Cleveland Institution of Engineers. He was, he said, having machines constructed for Sir James Joicey's collieries in Durham, where heretofore there had been no accurate weighing. "Billy Fairplay" had been used; but it was a rough method, and a more accurate mode of getting at the exact quantity raised and sent away was deemed advisable by the management. Again, at the Tyne Dock, where 25,000 to 35,000 tons of coal were dealt with daily, there were really no accurate means of weighing the coal. It arrived in 10-ton waggons; and the number of these formed the basis for calculating the weight delivered. One or two trucks were weighed now and then; and this became the standard until the next test weighing. Mr. Ingrey further remarked that, as in London many of the officials who have to do with gauging the weight of the coal are paid by the ton, such mistakes as are made generally favour the official.

In his paper, Mr. Ingrey enumerated the essential characteristics of a reliable coal-weighing machine, and described the apparatus designed by him to supply the want of such a machine. The machine must be sufficiently sensitive to be accurate in its weighings, yet it must be constructed in such fashion as to enable it to withstand all the heavy strains to which it can be subjected, and be free from delicate or complicated parts, so that it can be exposed to all weathers, and to the effects of coal dust, without loss of efficiency. It should be independent of all manual assistance, and be controlled entirely by the action of the crane or other unloading machinery. It must be rapid in its working, and be provided with a self-recording apparatus which would render disputes impossible. Such an apparatus Mr. Ingrey claims to have produced, and he described its construction, in detail, in the paper referred to. For this detailed description we cannot afford space, and will only say that the machinery appears to combine the two necessities of simplicity and efficiency. Messrs. Cory, who own the principal derricks in the Thames, are said to have spent £100,000 on a pontoon fitted with these automatic appliances; and if, as is contended, they prove satisfactory, similar machinery will doubtless be adopted by both buyers and sellers of coal.

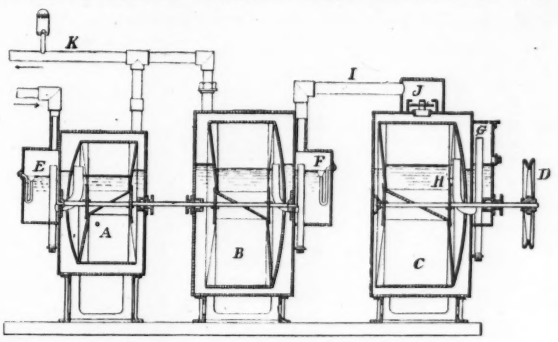
**Mr. R. Warington on the "Physical Properties of Soil."**—A few weeks ago, we referred to the issue by the Sulphate of Ammonia Committee of a pamphlet by Mr. R. Warington, formerly Sibthorpian Professor of Rural Economy in the University of Oxford, on "Sulphate of Ammonia as a Manure." He has also dealt with this subject in his "Lectures on Some of the Physical Properties of Soil," lately published by the Clarendon Press, and reviewed in the current number of "Nature." He points out that much of the success of manuring depends on the suitable relationship of fertilizers to soil and climate. Substances that are firmly held by the soil may be used without fear of loss, even on light soil and in a district of large rainfall; whereas substances for which soil has but little affinity must be applied with much discrimination. Other things being equal, sulphate of ammonia is more suitable than nitrate of soda for use in the West of England; whereas the order is reversed in the drier climate of the Eastern districts.

## REGISTER OF PATENTS.

**Apparatus for Mixing Air and Gas.**—Füller, E., of Berlin. No. 7443; April 8, 1899.

For mixing air and gas in constant proportion for illuminating, heating, or other purposes, certain appliances are, the patentee points out, usually employed, consisting of a gas-meter and an air-suction apparatus connected to operate in unison, and thereby deliver a mixture of gas and air to the discharge-pipe. Such appliances are, however, he says, unreliable, especially when the pressure of the gas is comparatively low, since the pressure required for driving, not only the gas-meter, but also the air-suction apparatus, is liable to become more or less reduced. The mixture of gas and air thus produced having a low pressure, would not, for example, be suitable for supplying incandescent gas-lamps, since the illuminating power would be thereby greatly reduced.

The present invention relates to improvements in such apparatus; and its objects are: First, to provide a device for supplying compressed air, and for conducting it to the air-suction apparatus, which serves as an




air-meter; and second, to provide a device for regulating the work of the first-named device. In such apparatus, the gas and the air are always mixed in a constant proportion; and the pressure of the mixture obtained can be kept at a convenient height, which is important for illuminating purposes, especially for supplying incandescent gas-lamps.

The illustration shows a vertical longitudinal section of the arrangement of a gas-meter, an air-meter, and an air-suction apparatus driven from without—all of similar construction.

A is the gas-meter, B the air-meter, and C the air-suction apparatus—all similar in construction to the common gas-meter. The drums of the gas-meter and air-meter are rigidly connected by a common shaft passing through stuffing-boxes. The drum of the air-suction apparatus is driven from the outside by means of a rope or band passing over a pulley D. As in a common gas-meter, the casings and the exterior chambers E, F, G are partly filled with water, glycerine, or the like. During its revolution, the drum C draws air through a sieve or grating on the top of the open chamber G, through the bent pipe H, and discharges it in a compressed state into the space above the liquid in the casing of C, and thence into the pipe I. To preserve the pressure of the compressed air in this pipe, a back-pressure valve J is arranged at the top of the casing. The compressed air is conducted by the pipe I to the drum of the air-meter, which will therefore be revolved by the compressed air. The gas is also conducted to the drum of the gas-meter A, which will likewise be rotated. Since the drums are rigidly connected, the compressed air and the gas under pressure serve to drive the two simultaneously; so that at each revolution invariable quantities of air and gas are discharged into the spaces above the liquids inside the casings. The compressed air conducted from the air-meter, and the gas from the gas-meter, enter the common main, K, where they mix together always in the same proportion. The mixture is then conducted further to the place of consumption—for example, to incandescent gas-lamps, or to motors, stoves, or other apparatus, as the case may be.

The portion of the gas and air in the mixture, of course, depends upon the size of the drums A and B, and upon the pressures of the gas and of the compressed air. The pressure in the main discharge-pipe K will equally depend upon the pressure of the gas and that of the compressed air conducted to the air-meter. It will be obvious that, by regulating the pressure of the compressed air, the pressure in the main discharge-pipe may be kept at a certain height. Any failure in the working of the apparatus will therefore be prevented, even when the gas pressure falls.

**Conveyor for Coke, &c.**—Jenkins, W. J., of Retford. No. 9116; May 1, 1899.

This invention relates to improvements in the De Brouwer apparatus—patent No. 23,770 of 1895—and has for its objects the reduction of wear and tear, and the addition of means for renewal without disturbing the general structure of the conveyor.

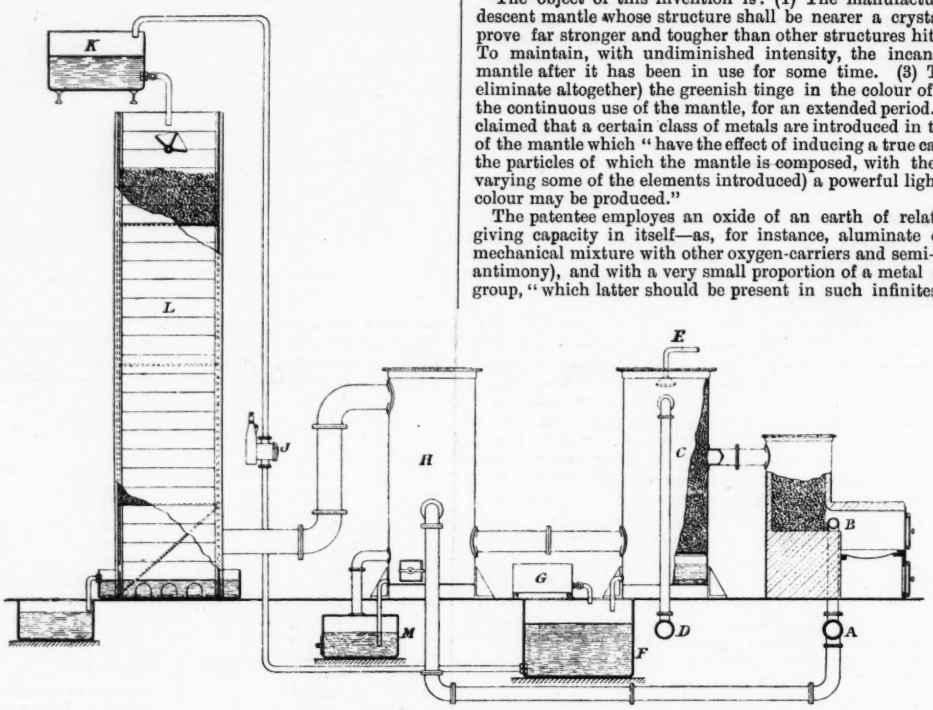
The invention consists in the addition to the floor or bottom of the trough or gutter of the conveyor of a plate of any required thickness, and two angle or flat metal strips or runners for holding the plate in position, and for forming surfaces upon which the wearing portion of the chains run when working. The invention also relates to the chains used in connection with the other parts to form a conveyor as specified in the 1895 patent. With the object of simplifying the chain, the block-links are made in the form shown in the earlier specification; but the side-links are forged or cast with bosses on each side-link, so as to meet in the centre of the corresponding block link; and they are then held together by means of a small rivet passing through the bosses of the two side links to keep them from coming apart when in work.

**Desulphurization of Sulphuretted Hydrogen.**—Hemingway, H. W., of Walthamstow. No. 9432; May 4, 1899.

This invention relates to the treatment of sulphuretted hydrogen, or gases containing sulphuretted hydrogen, with a view to the elimination

and recovery of the sulphur, and incidentally to the manufacture of sulphite of iron, sulphate of ammonia, and other useful products.

In treating the waste gases evolved in the manufacture of sulphate of ammonia, and in certain other processes, the patentee proposes to proceed as follows: He takes a portion of the sulphuretted hydrogen, and, by burning, converts it into sulphurous acid by any of the well-known methods; or (for the purpose of carrying out one part of the invention without the other part) he burns sulphur or sulphide of iron, or takes the gas from a pyrites kiln. The sulphurous acid gas (however obtained) is led into a tower packed with flint, stone, brick, coke, or other material; a like quantity of ammonia gas, obtained from sulphate of ammonia apparatus or any other available source of supply, being at the same time admitted. The sulphurous acid and ammonia gases, on mixing, form sulphite of ammonia, which, with the aid of a small quantity of water, is washed down the tower. To the solution of sulphite of ammonia, ferrous sulphate is added; sulphite of iron and sulphate of ammonia resulting. If it be desired to obtain all the sulphite of iron as well as the sulphate of ammonia in a fluid condition, the mixture should be slightly acid. Or, instead of washing down the sulphite of ammonia with water, a solution of ferrous sulphate may be employed, and the mixture of sulphite of iron and sulphate of ammonia directly produced.




Into a second tower, or other vessel adapted for effecting the intermingling of the gases, are led the noxious gases containing sulphuretted hydrogen; and down this tower, the solution of sulphite of iron and sulphate of ammonia yielded by the tower first referred to are rained. Or the sulphuretted hydrogen gas may be forced into a vessel charged with the mixture of sulphite and sulphate. In either case part of the sulphuretted hydrogen reacts with the combined sulphurous acid, and forms free sulphur; while a further part of the sulphuretted hydrogen unites with the iron and forms sulphide of iron. Both of these products being solids, the solution of sulphate of ammonia can be filtered off and run into the saturator ordinarily employed in the manufacture of sulphate of ammonia.

Instead of taking the mixture of sulphite of iron and sulphate of ammonia, and exposing it to the influence of sulphuretted hydrogen as described, the solid sulphite of iron is separated by subsidence, filtration, or other known means, from the sulphate of ammonia, and then the former is used in a manner similar to that in which hydrated peroxide of iron is employed in the purification of coal gas. Or the sulphite of iron may be mixed with water, and reduced to such a consistency that it will flow down a tower, and thus be rendered serviceable for the absorption of sulphuretted hydrogen as already described.

In the purification of coal gas, in order to eliminate the sulphuretted hydrogen, the sulphite of iron is used as previously described—either alone or mixed with sawdust or other porous materials—an ordinary purifier being employed. Or the sulphite of iron is exposed in a scrubber to the action of the gas containing sulphuretted hydrogen. In either case, "the sulphuretted hydrogen is absorbed with great rapidity, and only a small amount of sulphite of iron is needed to act upon and absorb a large amount of sulphur."

An arrangement of plant adapted for carrying the process for the desulphurization of sulphuretted hydrogen into effect is shown in the engraving.

The gas containing sulphuretted hydrogen arrives by the pipe A. A portion is conducted to the furnace B, whence it escapes, in the form of sulphurous acid, to the tower or scrubber C; while ammonia or ammoniacal gas, which arrives by the pipe D, is led to the upper portion of the tower. The coke or like porous material, with which the tower is charged, is traversed by a stream of water, which enters by the pipe E; the sulphite of ammonia being thus washed down as it is formed, and flows to the tank F. The surplus sulphurous acid is led to another tower H, the function of which will be referred to later. The tank G contains a solution of sulphate of iron, a regulated supply of which is delivered to the tank. Upon the sulphate of iron mingling with the sulphite of ammonia, reactions take place which result in the production of a mixture of sulphite of iron and sulphate of ammonia; and this mixture passes to the pump J, and thence to the tank K, whence it is delivered to a third tower L. This tower is furnished with coke or like material, through which the liquid mixture passes; the sulphuretted hydrogen, admitted at the lower part of the tower, passing in the opposite direction. There is a device of the "bascule type" for distributing the mixture of sulphite and sulphate over the porous material carried by the perforated trays. In the tower, sulphide of iron and free sulphur are deposited as solids, while a solution of sulphate of ammonia overflows.

Returning now to the tower H, the sulphuretted hydrogen, as it enters, combines with the sulphurous acid, with the result that water and thionic acids are formed and free sulphur deposited; while the water and acid escape to the tank M, which is charged with scrap iron. The thionic acids are here decomposed; sulphide of iron being formed, while sulphuretted hydrogen is liberated. The latter escapes, and returns to the tower H.

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**Mantles for Incandescent Gas Lighting.**—Boult, A. J.; a communication from F. Isitt, of Leichhardt, N.S.W. No. 16,166; Aug. 8, 1899.

The object of this invention is: (1) The manufacture of an incandescent mantle whose structure shall be nearer a crystalline form, and prove far stronger and tougher than other structures hitherto used. (2) To maintain, with undiminished intensity, the incandescence of the mantle after it has been in use for some time. (3) To reduce (or to eliminate altogether) the greenish tinge in the colour of the light, after the continuous use of the mantle, for an extended period. Moreover, it is claimed that a certain class of metals are introduced in the manufacture of the mantle which "have the effect of inducing a true catalytic action in the particles of which the mantle is composed, with the result that (by varying some of the elements introduced) a powerful light of any desired colour may be produced."

The patentee employes an oxide of an earth of relatively low light-giving capacity in itself—as, for instance, aluminate of glucinum, in mechanical mixture with other oxygen-carriers and semi-metals (such as antimony), and with a very small proportion of a metal of the platinum group, "which latter should be present in such infinitesimal quantity, and so distributed through the mass, that its presence will be discoverable only by its oxygenizing action, and which action, in the absence of such platinous metal, would not be produced."

It has, says the patentee, been shown in Williams's patent that a large (almost white) light will be produced if lanthanum and yttrium be added to zirconium in the following proportion: 60 per cent. of zirconia, 20 per cent. lanthanum, and 20 per cent. yttrium. Or the oxide of yttrium may be dispensed with; the composition being then 50 per cent. zirconia and 50 per cent. lanthanum. Carl Dellwik, in his English patent, No. 2110 of 1890, maintains that a powerful red light may be produced from a base of zirconium, to which a small proportion of chromium is added. It is also described by Welsbach, in his patent of 1894, that thorium in a pure state gives comparatively little light; but when there is added to it a small proportion of the oxides of certain rare metals—such as cerium, terbium, neodymium, samarium, praseodymium, yttrium, and lanthanum—it has a high illuminating power. It has further been shown that the oxide of cerium was found to act upon, and to excite, the thorium; resulting in a marked increase in illuminating power. It has, moreover, been asserted that various other combinations or ingredients possessing similar exciting properties, may be used for a like purpose. In such cases, thorium or zirconium oxides have been generally proposed, as being most suitable to form the main body or mechanical base, with a small quantity of the oxide of one or more rare earths mechanically combined therewith. Although such oxides of rare earths may, in some instances, be of service, they are rather theoretically than practically useful as exciting media, when considered from the commercial point of view.

The patentee claims to have discovered, after a thorough practical investigation of the subject, that, in the total absence of cerium oxide, none of the earths mentioned have the power of appreciably increasing the light from a mantle composed mainly of thorium oxide or of the oxides of other earths. Wherever such increased illumination has resulted, it has been due to the presence of a trace at least of cerium oxide, an exceedingly small quantity of which will give wonderfully improved results. Oxide of cerium is the only one of the cerite and yttrite groups of earths which is, for this purpose, of practical commercial value. He has further discovered that the oxides having the above-mentioned properties may be divided roughly into two classes, which he designates as "carriers" and as "developers."

"Carriers" are oxides of high melting point, and are stable—such as aluminium, glucinum, zirconium, calcium, magnesium, and thorium. They are called "carriers" because they form a large proportion of the whole, and thus serve as bases or carriers for the light-developers, which

are in much smaller relative proportions. Indium and gallium are peculiar, inasmuch as they may be used to an appreciable extent both as carriers and as semi-developers. There are a number of other elements which partly possess this property, and others again which only possess it, to some extent, in the presence of related oxides. "Developers" of light and colour are variable oxides according to their degrees of volatility —such as cerium, manganese, indium, gallium, chrome, and such like. On these will depend the light, the colour, and the relative permanence of the incandescent life of the mantle.

The oxides of glucinum, aluminium, zirconium, thorium, magnesium, calcium, and such like elements, and their various mixtures and compounds, are of no considerable value in themselves for the production of mantles for incandescent lighting; but the addition of a small proportion of vari-colour semi-accelerators or "developers," in combination with a very small proportion of a true exciter or "developer," consisting of some metal of the platinum group, will give a powerful incandescent light, which may be varied in colour (according to formulæ) from red to almost white.

The true "developer" which (he says) should be platinum, iridium, or other suitable metal of the platinum group, is introduced in order that a true catalytic action may be set up; and this constitutes one of the main features of the invention. The catalytic action is due to the fact that a platinous metal has great mechanical affinity for oxygen—possessing the faculty of attracting the gas from the atmosphere, and maintaining it in large quantities on its surface. It was shown by Döbreiner, in 1825, that platinum has the power of holding 100 volumes of oxygen. The platinum, though incapable of chemically combining with oxygen, will collect and maintain a large supply of the gas over the surface of the mantle; and the oxygen, combining with the gas from the burner (as supplied constantly to the flame on the inner side of the mantle) will cause more perfect combustion of the hydrocarbon gas. To all appearance, this action is continuous; but as a matter of fact, it is really alternate or intermittent, as may be seen by the result. The greater heat which is due to the presence of additional oxygen, causes the incandescence of the mantle, which serves as a radiating, diffusing, or distributing body for throwing off the light thus developed.

The precise mode of making the mantle is not of great importance; but, in practice, the fabric employed must be impregnated with a solution consisting of soluble salts of aluminium in the proportion of from 20 to 40 per cent., together with soluble salts of glucinum in the proportion of from 20 to 40 per cent., dissolved in water, and with or without oxides of incandescent earths of relatively low light-giving capacity in themselves. The proportion of the combined salts of aluminium and glucinum may thus vary from 40 to 80 per cent. of the whole. Instead of dipping the filamentary fabric into the solution of the combined salts of aluminium and glucinum, mixed with the oxides of incandescent earths, it may be first dipped into a solution consisting only of the salts of aluminium and glucinum, then dried, and afterwards dipped in (or sprayed with) a solution of the oxides of incandescent earths. In any case, the mantles thus far prepared will consist only of "carriers."

It may be advisable to further treat the base or body thus formed, impregnated, and dried, by dipping it into an alkali-fixing solution (preferably aqua-ammonia), or by introducing it into an atmosphere of ammonium hydrate, whereby the salts of the metals will be decomposed, and a coating formed of hydrated oxides and the corresponding salts of ammonia. It should then be partly dried again, and the salts of ammonia washed out in distilled water, to prevent injurious reactions in the frame-work.

The mantle, after having been dried and shaped, is burnt out over a gas-flame in the usual manner; and thus the "scaffolding" (consisting of the stockinette or other filamentary fabric) is destroyed, while the oxides or body of "carriers" constituting the framework is left in the form of a mantle.

The oxides of the minerals are now in the proportion in which the chemical compound consisting of glucinum aluminate is formed. This compound framework or base, although artificially produced, possesses great infusibility and unalterability, and is quite stable. The framework or "carrier" is then dipped into (or sprayed with) a solution of a "developer" composed of one or more of the catalytic incandescing bodies hereafter referred to. When the mantle has been treated with the required "developer," it may be advisable to again subject it to the action of ammonia gas, as before explained, in order that the developer salts may be decomposed; and then, in order to properly unite the "developers" with the "carriers," and to ash the chlorides of platinum or iridium (which in the meantime have been transformed to their hydro-oxides), it is necessary to again burn out the mantle. The result of this will be to leave an ash of the oxides or "developers" with a very minute proportion of platinous metal so distributed over, or throughout, the mass as to produce the desired catalytic action.

It will be remarked that the fundamental principle involved in this invention is that the mantle shall be composed of a stable base called the "carrier," and an exciting medium called the "developer," which must contain a minute quantity of some metal of the platinum group, whereby a true catalytic action is set up. The platinous metal or metals which are utilized to produce the catalytic action should be applied in the form of chlorides; and when the mantle is burnt out, these metals will exist neither as salts nor as oxides, but as chlorides transformed to metallic platinum or iridium, and distributed in minute quantity throughout or over the surface of the oxygen "carriers."

The proportions of the ingredients used, and the selection of ingredients themselves, which constitute the "carriers," the "semi-developers," the colour-producing oxygen "carriers," and the catalytic excitant or "developer," will be varied, according to the illuminating power required, the colour of the light, and the desired stability of the mantle.

The following schedule will give a fair idea of the combinations of minerals which may be used as "developers": (1) For a white light: Solution of soluble salts of aluminium or other stable "carrier," indium, or gallium, with a trace of chloride of iridium. (2) For a yellowish white light: Solution of soluble salts of aluminium or other stable "carrier," gallium, or indium, calcium, and a trace of platinum chloride. (3) For a ruddy or pinkish white light: Aluminium or other stable "carrier," gallium, pent-oxide of vanadium, iridium chloride, and platinum chloride. (4) For a ruddy white light: Aluminium or other stable "carrier," calcium, cobalt, tungsten, and platinum chloride. (5) For a reddish yellow light: Aluminium or other stable "carrier," indium, chromium barium, and platinum chloride.

By varying the proportions, almost any shade of colour from nearly white to a yellowish red may be produced.

The following will serve to illustrate a "carrier" solution:—

| | |
|---|---|
| Soluble salts of aluminium, or other stable "carrier" . . | 49·98 |
| Soluble salts of glucinum . . . . . | 49·98 |

To which may be added one or more of the following ingredients, which will act as strengtheners: Calcium of magnesium, from 0·1 to 0·04 part; pyrotartaric acid, 0·1 part; chloride of antimony, 0·5 part; water to be added until the desired strength is obtained.

It will be understood that to 99·96 parts of the "carrier" must be added a trace of a metal of the platinum group, in the proportion of from 0·03 to 0·06 part.

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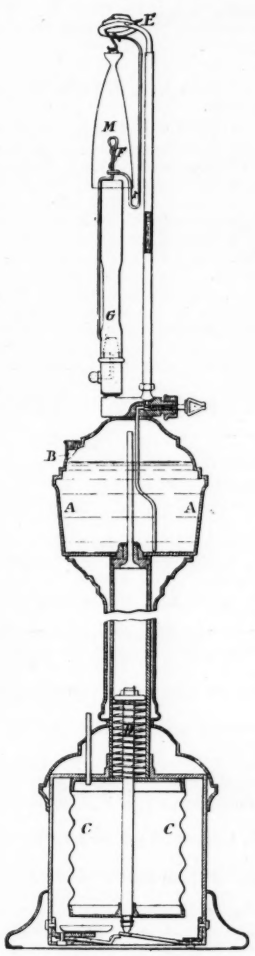
**Incandescence Lamp.**—Denayrouze, L., of Neuilly, France. No. 9690 May 8, 1899. Date claimed under International Convention, Oct. 18 1898.

According to this invention, water is forced by air pressure in a small adjustable stream to a vaporizer situated above the mantle; and from this, vapour descends and (passing through a coil situated in the heart of the flame) becomes more or less dissociated with hydrogen and oxygen, which mingle with the gas that supplies the bunsen burner. The pressure of the hydrogen and oxygen in the flame "greatly increases the luminosity of the mantle heated by the burner flame." The patentee says that he has "found that, by passing a small quantity of water vapour through a tube situated near to, or in the centre of, the very hot burner flame of an incandescence lamp, dissociation takes place, so that the resulting gaseous oxygen and hydrogen is being led to the lower end of the bunsen burner, and there combining with supply of the combustible gaseous mixture, a considerable rise of temperature is produced in the burner flame, resulting in a greatly increased luminosity of the mantle."




The construction of lamp shown in the engraving is arranged to work with ordinary illuminating gas and dissociated water vapour. It comprises a reservoir A to contain the water, which is introduced at B. Air under pressure is sent in above the water in the reservoir, by a bellows C, charged with air by means of a suitable air-forcing device. The bottom plate of the bellows has a rod, the top of which is fixed to a washer, which bears upon a spring D so as to compress it when the bellows is distended; and the expansion of the spring compresses the bellows, and forces air into the reservoir A. The lower end of the rod, when the bellows is charged, depresses a blade spring, which works the hammer spring of an alarm gong, so as to give notice when the bellows is completely charged. The air as discharged passes through a small tube to the space above the water, which by the pressure is sent upwards in a thin stream; while a screw-valve regulates the quantity of water before it reaches the vertical tube which extends upward along the incandescent mantle M. This tube may be filled with fine wires—very good conductors of heat. The water, thus already heated a little, reaches the vaporizer E arranged above the incandescent mantle. The vapour formed descends through a small tube parallel to the mantle, till it reaches the coil F situated in the hottest part of the burner flame, and in which dissociation of the water vapour takes place. The gases resulting from the dissociation descend to the base of the burner G through a tube, which there bends inwards and leads the hydrogen and oxygen gases resulting from the dissociation to the base of the bunsen burner, quite close to the pipe through which the ordinary gas is supplied to the burner-nipple.

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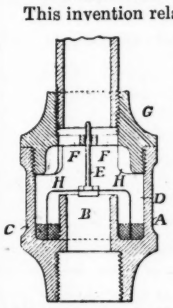
**Automatically Sealing Gas-Supply Pipes to Burners.**—Sugg, W. T., of Westminster. No. 10,506; May 18, 1899.

This invention relates more particularly to incandescent gas lighting, where the gas is supplied under considerable pressure; but it is also applicable to ordinary gas lighting—especially where a number of lamps provided with pilots are to be lighted by the turning on of a common main cock, instead of turning on each separate burner.




When gas is turned off at the main (each burner being left "on"), it is well known, says the patentee, that the gas left in the pipes will gradually escape through the burners, and the pipes will become filled with air. In the case of incandescent lighting, this is fatal, for two reasons: First, that the rush of air out of the pipes, when the gas is again turned on, may, and in all probability will, blow out the pilot, so that the burner will have to be relighted; secondly, an explosive mixture is formed, which, on coming into contact with the pilot

(if alight), will explode, and shatter the mantle. Consequently, the object of the present invention is to provide an appliance to be placed just below each burner, which will automatically seal the gas-supply pipe when the gas is turned off at the main, and thus prevent the escape of the gas, and which will automatically unseal the supply-pipe when the gas is turned on again—in other words, keep the service-pipes full of gas when the main cock is turned off.

The casing A is attached to the supply-pipe; while B is an internal cylinder, which forms the inlet to the casing for the gas, and is so arranged that a gutter C is formed externally thereof. D is a bell or cup, intended to fit over the inlet of B, and dip into the gutter, which contains mercury. The bell or cup has a guiding-stem E, which works in a cross-piece F formed on the cover G below the outlet. This cover is provided with radial projections H, which serve as stops to limit the movement upwards of the bell or cup, which may, if desired, be weighted.

When the gas is turned on at the main, the cup of each appliance will be raised, and kept up by the pressure of the gas in the main—a clear way being thus provided to the burner. But directly the gas is turned off at the main, the cup will descend into the mercury; and the supply-pipe will be effectually sealed against the passing out of the gas. Thus the supply-pipe (assuming it is sound) will be kept full of gas; and the disadvantages before-named will be obviated.

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**Gas-Engines.**—Marks, G. C.; a communication from J. P. Murphy, of Philadelphia. No. 20,323; Oct. 10, 1899.

This invention in gas-engines has for its object "the general improvement of engines of this kind"—the leading feature of the invention consisting in a combination of a four-cylinder engine with a two-crank shaft, whereby an explosion takes place for each half-revolution of the shaft. Another feature consists in "a novel valve or valve and igniter mechanism, characterized by great simplicity, and applicable with advantage to two-cylinder engines, although especially adapted for the four-cylinder type." Still another feature of the invention consists in a device for governing the action of the admission-valves. The patentee says he has also in the development of his engine made improvements in the starting mechanism, in the igniting mechanism, in the construction and combination of the shaft, fly-wheel, and shaft-bearing, and in various other parts of the mechanism, as pointed out in a lengthy description and his claims. Reference in the specification is then made to the drawings in which the invention is illustrated—ten sheets of details in all, explained by five sheets of text, which it is impossible to summarize intelligibly.

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### APPLICATIONS FOR LETTERS PATENT.

6076.—Hillier, W. H., "Oil and gas engines." April 2.
6137.—Kent, W. G., and Gordon, J., "Valve applicable to indicators or meters." April 2.
6164.—New, A. G., "Internal combustion engines." April 3.
6170.—Firth, A., and Jackson, R., "Carburetting apparatus." April 3.
6184.—Hauslich, S. H., "Carburetting air." April 3.
6213.—Golby, F. W., "Incandescence gas-burners." A communication from A. Müller. April 3.
6237.—Schwarzenbach, J., "Electrical gas-igniting apparatus." April 3.
6278.—Whitham, C., and Large, E., "Prepayment meters." April 4.
6304.—Albrecht, A., "Lamps." April 4.
6329.—Winkler, H., "Ignition devices for incandescent gas-lamps." April 4.
6330.—Winkler, H., "Raising and lowering gas-lamps." April 4.
6361.—Bray, G., "Gas-burners." April 5.
6369.—Potter, W. G., "Mantle for incandescent gas-light." April 5.
6391.—Ashley, H., and Martin, H. M., "Liquid meters." April 5.
6425.—Potter, W. G., "Burners for incandescent gas lighting and for heating purposes." April 6.
6465.—Légeret, E., and Lombard, F., "Gas and petroleum motors." April 6.
6467.—Mills, B. J. B., "Oil or gas engines." A communication from A. Eldin. April 6.
6483.—Graham, J., "Controlling the flow of fluids." April 6.
6512.—Jeffery, F. W., "Burners for incandescent gas lighting." April 7.
6532.—Greenall, J., "Gas and like fluid meters." April 7.
6563.—Naef, P., "Recovering products from fuel." April 7.

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## PARLIAMENTARY INTELLIGENCE.

### HOUSE OF LORDS.

The following further progress was made with Private Bills down to the adjournment on the 9th inst. for the Easter holidays:—

Bill presented, read the first time, and referred to the Examiners: Gas and Water Orders Confirmation Bill (Hoylake and West Kirby Gas and Water, Manningtree and Mistley Gas, South Elmsall, South Kirby, and North Elmsall Gas, and Steyning and District Water Orders).

Bills read a second time and committed: Ossett Corporation Gas Bill, Wetherby District Water Bill.

Bills read the third time and passed: Dorking Water Bill, Exmouth Urban District Water Bill, Fishguard Water and Gas Bill.

### HOUSE OF COMMONS.

The following further progress was made with Private Bills down to the adjournment on the 9th inst. for the Easter holidays:—

Lords Bills read the first time and referred to the Examiners: Dorking Water Bill, Exmouth Urban District Water Bill, Fishguard Water and Gas Bill, Kingston-upon-Thames Gas Bill, Mountain Ash Water Bill.

Lords Bill read a second time and committed: Newport (Mon.) Gas Bill.

### HOUSE OF COMMONS COMMITTEE ON POLICE AND SANITARY REGULATIONS BILLS.

**Wednesday, April 4.**

(*Before Lord* E. Fitzmaurice, *Mr.* H. Bemrose, *Mr.* Bill, *Mr.* Heywood, *Mr.* Johnstone, *Mr.* Leuty, *Mr.* M'Kenna, *Mr.* H. J. Wilson, *Mr.* J. W. Wilson, *and Mr.* Wylie.)

#### BRADFORD CORPORATION BILL.

This Bill, which is to authorize the Corporation of Bradford, among other things, to acquire land for the protection of their water supply, to purchase the undertakings of the Clayton, Allerton, and Thornton Gas Company, and the North Bierley, Eccleshill and Bolton, and Airedale Gas Companies, and to purchase gas from the Drighlington and Gildersome Gas Company, came before the above-named Committee to-day.

The following Counsel were engaged in the case: For the promoters Mr. Balfour Browne, Q.C., Mr. Freeman, Q.C., and Mr. Waugh; for the Drighlington and Gildersome Gas Company, Mr. Worsley Taylor, Q.C., and Mr. Gerald FitzGerald; for the Airedale Gas Company, and the Clayton, Allerton, and Thornton Gas Company, Mr. J. D. Fitzgerald, Q.C., and Mr. Moon; for the North Bierley Gas Company, Mr. Wedderburn, Q.C., and Mr. H. Lloyd; and for the Eccleshill and Bolton Gas Company, Mr. Claude Baggallay, Q.C., and Mr. Lloyd. In the case of other petitioners, Counsel were reserved.

Mr. Balfour Browne, in opening the case, said the only part of the Bill that was really opposed was that relating to the purchase of the gas undertakings; and the Drighlington and Gildersome Company also objected to the powers the Corporation of Bradford were seeking to enable them to purchase from the Company gas in bulk, and to supply it in the borough. Bradford was incorporated fifty years ago, and was made a city in the year 1897. It was the centre of the worsted industry; and the population to-day was nearly 300,000. The borough was largely extended last year; and the rateable value of Bradford to-day was £1,368,109. The city had spent, on improvements and works for the benefit of the people of Bradford, and also for the benefit of the people round about it, on gas-works, water-works, electricity works, tramways, and markets, about £6,000,000. The Corporation owned the whole of the works that were supplying gas within the old borough of Bradford. The borough was extended last year by taking in Airedale or Idle, Eccleshill, Tong or Drighlington, North Bierley, and Thornton. The Corporation had gone for an extension of the borough under section 54 of the Local Government Act of 1858. The matter was referred to the Local Government Board, who deputed one of their officials to make a local inquiry. This inquiry was duly made, and lasted for eight days, with the result that, although the Local Government Board Inspector did not give them for inclusion within the city boundary the district at the north called Shipley and the wedge-shaped district called Clayton, all the rest of the area which was included in the scheme of the Corporation was by Provisional Order added to the borough last year. At that time, the Gas Company in the North Bierley district said: "We want to be left alone;" and he (Mr. Balfour Browne), appearing then for the Corporation, replied: "There is no intention by this Order to affect the Gas Company at all; and we will put in a proviso that nothing in the Order shall affect the position of the Company." But at the same time, he said: "We propose to come for a Bill to purchase your undertaking at the very earliest opportunity, because we think that, as the people of old Bradford are supplied with gas by the Corporation at a cheap rate, it would be an anomaly to leave the people of North Bierley to be supplied by the Company at a dear rate. We think all the people of Bradford ought to be supplied with gas at precisely the same price." He had said then, "We will come for a Bill to purchase your undertaking." It was to redeem that pledge that this Bill was brought forward. He had referred specifically to North Bierley, only by way of illustration; for, of course, his remarks had applied to the districts in which the three other Gas Companies had undertakings. The Corporation of Bradford entered into an agreement at that time with the urban district of North Bierley, that they would come for this Purchase Bill; and the agreement was to the effect that the Corporation undertook, if any Order was made in pursuance of their representations providing for the inclusion of the urban district of North Bierley within the boundary of Bradford, they would procure the insertion of clauses requiring them to improve the district as to tramways, and so forth. In the schedule, it was stated that the Corporation would take such steps as were necessary, by a Purchase Bill or by arrangement, for the supply of of gas in bulk or otherwise, to enable them to furnish gas within the added area; and if they so supplied gas, they should do so at the same price as was for the time being paid by the inhabitants within the existing area. They had a similar agreement with the Idle, the Eccleshill, the Tong, and the Thornton authorities. The Corporation purchased the Bradford Company's works in 1871; and the undertaking had been supplying the centre of the borough. It had cost the Corporation £622,563; and they had made very considerable profits, which had been applied in relief of the rates within the borough. They had four manufacturing stations, and supplied gas over an area of 7321 acres. The area of the borough, however, was now extended, and embraced 22,721 acres; and the desire of the Corporation was to supply with gas the whole of that area, and not merely a part as they did at the present time. The amount of gas supplied was 1687 million cubic feet per annum. The whole of the Companies whose undertakings they were seeking to purchase only supplied 265 million cubic feet in the year. The price in Bradford was 2s. 1d. per 1000 cubic feet, in North Bierley 2s. 10½d., in Eccleshill 2s. 11d., in Idle 3s. 0½d., in Clayton, Allerton, and Thornton 2s. 6d., and in Drighlington 2s. 7d. The illuminating power of the gas in Bradford and the districts was: Bradford 18 candles, Eccleshill 14, Idle or Airedale 16¾, Clayton, &c., 16½, Drighlington 16, and North Bierley 17. From this it would be seen that the gas of the North Bierley Company was the best from an illuminating point of view of any supplied by the outside Companies. It would also be seen, however, that the Bradford gas was 1 candle better than that of North Bierley. Well, very naturally, the people in the parts of the borough supplied by the Companies objected to going on paying 2s. 7d. or 3s. for an inferior description of gas, while

they could obtain it from the Corporation at a lower rate and of a better quality. Therefore, when they were coming inside the Bradford boundary, they bargained with the Corporation that the latter should come and ask for this Bill; and here they were accordingly. At the present time, in old Bradford no one except the Corporation had the right to break up the streets; and they regarded this as a matter of the utmost importance. It was a serious nuisance to the town to have three or four different authorities dealing with the streets; and a considerable amount of friction consequently took place between the Gas Companies and the Corporation. This always occurred in cases where Companies had the power to break up streets, and had to replace them to the satisfaction of the Corporation. As he had said, in the old town no one but the Corporation had the right to break up the streets; but in all the added districts to-day, the Gas Companies had this right. When the Corporation purchased the gas undertakings, the whole borough would be put under the same provisions as Bradford. In consequence of the lesson they had had last year, the Corporation proposed, in the case of the four Companies he had mentioned, to purchase the whole of their undertakings. Last year Parliament, though approving of the purchase of the gas undertakings, did not approve of their purchasing a part of them; and therefore they refused the powers which were asked for. Now, the Corporation were seeking to purchase the whole of the undertakings. They did not, however, wish to supply those places outside the borough which were in the area of supply of the local authority, if the authority chose to take the works outside the borough into their own hands. Therefore they proposed, with regard to Clayton, Allerton, and Thornton, to take the whole undertaking, and pay the full price for it. There was a dismembering clause in the Bill, giving those parts of the district not in the borough the right to purchase mains, pipes, fittings, and so forth, in those areas from the Corporation on arbitration terms. If the district did so, then it would be supplying itself with gas; Bradford would be supplying its own part. But the Corporation were willing to go on furnishing the districts with gas, if they did not choose to exercise their powers under the dismembering clause, and purchase their gas from the Corporation. There were a dozen precedents where, in such a Bill as this, Parliament had sanctioned the purchase of the whole of an undertaking. He did not know an instance in which Parliament had sanctioned the purchase merely of a portion of an undertaking. In one notable case of last year—that was to say, the purchase or attempted purchase by the Southampton Corporation of a portion of the South Hants water undertaking—a Committee of the House rejected the Bill, on the ground that it was only proposed to purchase a portion of the undertaking. Dealing with the Clayton, Allerton, and Thornton Gas Company, they were authorized in 1864. The amount of gas sold by the Company in 1899 was 70 million cubic feet, of which about 40 millions were consumed within the portion of the district which was part of the city of Bradford. The area of the Company's district was 3981 acres within the city; and outside it had left 6751 acres. The difference in the price of gas between the Corporation and the Company was 5d. per 1000 cubic feet. In 1897, the Company offered to sell their undertaking to the Corporation, and negotiations took place; but the Corporation considered that the price the Company asked was much too high, and the idea fell through. The Company were at that date willing sellers. The whole question was one of price; and when that was the case, the only way to determine the figure was not to allow either party to settle it, but to call in an Arbitrator. But even if the Company were not willing sellers, what injury, he asked, could be done to the shareholders through purchase by arbitration? An Arbitrator, having heard the evidence, would give the shareholders a capital sum representing their income; and they could invest that in any other security of a like nature, and get the same income. The North Bierley Company was established in 1863. The gas sold by them was 78½ million cubic feet yearly. Of this, 64 millions were consumed within the city; and the difference in price between the Company and the Bradford Corporation was 9¾d. per 1000 cubic feet. The Eccleshill Company was established in 1870; and their works were in Eccleshill, though the whole of their district was within the city. The quantity of gas sold by the Company in 1899 was 25½ million cubic feet; and the difference between their charges and those of the Corporation for gas was 10d. per 1000 cubic feet in favour of the Bradford consumer. The Airedale Gas Company was incorporated in 1870. Practically all their consumers were within the borough; there being only a small area outside, where there were very few consumers. The difference in the price of the Corporation and the Company was 11¼d. per 1000 cubic feet. These were all the Companies it was proposed to purchase. In their petitions, they said the purchase should not be allowed; but after hearing the evidence, he would ask the Committee to say it would be for the benefit of the gas consumers, who were the people to be regarded, that the purchase should take place. If he could convince them that the shareholders, as investors, would be no worse off, and that the consumers would be better off, he thought they would pass the Bill. There had been many cases in which gas companies had had their undertakings compulsorily purchased; and he mentioned the recent instances of Ossett, Loughborough, and the earlier cases of Ilkley, Matlock Bath, and Morley. He really thought the argument was stronger for purchase where there was no complaint, than where there was. It was a fact, he believed, that in many cases—some of water companies—where there had been complaints, a Bill to purchase had not passed. In the case of Eastbourne, after a series of dry years, the Water Company commenced pumping water which was very much charged with salt water. The Corporation immediately took advantage of the accident, complained, and promoted a Bill for purchase. The Company urged that it was hardly fair of the Corporation to step in and buy when they were in default by a mere accident; and the Bill was rejected. On the other hand, in the case of Harrogate there was absolutely no complaint; and it was pointed out that, this being so, when the transfer took place the Company would get a higher price. The Bill passed, and now the water-works were in the hands of the Corporation. The question to be considered here was whether any injustice would be done. It would commend itself to everybody that all people in the borough, who had to bear the risk and cost, should have gas at the same price; and this could only be obtained by purchase—fair compensation to the Companies being secured by provisions as to arbitration. With regard to Drighlington, part of which was taken into the borough under the Order of 1899, the gas-works were situated outside the borough, in Gildersome. As Bradford only secured half the area, they thought it would not be fair to take the gas-works. Therefore, while adhering to the principle that everybody should pay the same price for gas, they proposed to buy gas from the Gildersome Company on arbitration terms, though very likely they might have to pay more than would be charged to the people in the borough. The petitions were very similar; and he would only deal with one. The Clayton Company said they had not hitherto paid nearly the full dividends which they might have paid under their Act, and that the profits which they would derive in future would be much greater than in the past. But this would be considered by the Arbitrator.

Mr. *Frederick Stevens*, Town Clerk of Bradford, was examined by Mr. WAUGH. He gave evidence of a formal nature in support of the Bill, and handed in a table of nineteen cases in which gas companies had been compulsorily acquired by local authorities.

In cross-examination by Mr. J. D. FITZGERALD, witness said he put the table before the Committee as showing precedents for the proposal of the Corporation. He did not know that in Chesterfield—one of the precedents—the people for weeks had been receiving practically no water. He was not acquainted with the details of the cases. In their Local Act of 1881, a clause was inserted that the Bradford Corporation should not supply gas within the district of several Gas Companies, including that of the Clayton Company; and under that Act Allerton was annexed to the borough. He did not consider that the Corporation were now seeking to repeal the condition on which Allerton was annexed. The Gas Company opposed the further extension of the borough last year; and to "lighten the ship"—not altogether to get rid of the Company's opposition—the clause was inserted that the Corporation were not to supply gas within the districts of the Company, nor to interfere with their rights. It was the intention of the Corporation then to come to Parliament again with the present application. The sole object of the proviso in the Bill was to pervent competition. The equality-of-charge clause was not extended to the portion of the Clayton Company's area which was outside the borough; but the Corporation would not be able to charge consumers there what prices they liked. Such consumers would be no worse off, because the Acts at present in force would remain operative. He agreed, however, that the Corporation could charge them the maximum of 5s. per 1000 cubic feet; the actual present charge being 2s. 6d. These consumers would not be constituents of Bradford; but while it might be to the interest of Bradford to charge them as much as possible, he did not think Bradford would do so.

Cross-examined by Mr. WEDDERBURN: The North Bierley Company had an area of some 10,000 acres, of which about 4000 were within the borough. Besides the Companies Bradford sought to buy, there were three others inside the borough, which would no doubt be dealt with later on. The Corporation failed in their proposals with regard to them last year. The principle on which the Corporation acted in dealing with some and not with other Companies, had relation to the agreements with the districts which came in on the extension of the city. Under the Provisional Order of last year, North Bierley was to be charged differential rates of 4s. 10d., as against the city rate of 6s. 4d., until gas was as cheap in North Bierley as in the city.

Mr. WEDDERBURN put it to witness that, if the present Bill passed, the charge for gas would be reduced from 2s. 11d. to 2s. 1d. per 1000 cubic feet, entailing a loss to the Corporation on the present consumption of £2798; but that the differential rate would then disappear, and the full rate of 6s. 4d. be charged, upon which the Corporation would make a profit of £4974.

*Witness* did not agree. He believed the figures had been carefully worked out, and that they showed that for the present the Corporation would make a distinct loss, even with the added rate.

Cross-examined by Mr. GERALD FITZGERALD, for the Drighlington and Gildersome Gas Company, witness said he had no complaint to make against the Company. The question in the case, so far as they were concerned, was whether any injustice would be done—that was to say, should the clause dealing with them be shown to be unjust, it would not be pressed. Mr. Balfour Browne had said that to take a part of the Company's undertaking would be unfair, and that he knew of no precedent for it. But there was in the Act of 1881 a precedent, even in Bradford, for taking two small portions of gas undertakings. The Bill did not propose to purchase the whole or part of the Drighlington undertaking, but to purchase, on arbitration terms, the quantity of gas which the Company at the time of the purchase were supplying in the parts of the limits of supply within the district of Harroworth. If the supply at present was 30 million cubic feet a year, Bradford would take this quantity from the Company. It was proposed that the gas should be measured at the boundary. The 30 million cubic feet would be taken in perpetuity. It might be that this would include the best section of the Company's area of supply. If the district grew and wanted more than the agreed quantity taken from the Company, it was proposed that Bradford gas should be supplied. He was not aware of a compulsory clause in any Act requiring a company to supply gas in bulk to a corporation.

Cross-examined by Mr. LLOYD, for the Eccleshill and Bolton Gas Company, witness said he thought the present was an opportune time for purchase. It was proposed to buy all the undertakings as going concerns; but it was not proposed to sell under Clause 33a, relating to dismemberment, those parts of the undertakings outside the extended area of the borough at old-pipe price. The Bill had been altered within the past two days on this point, so as to make the matter clear. The local authorities now knew that they were to pay at goodwill price. He did not know that Clayton had been informed that they would have to buy at goodwill price. The Bill as originally framed had not contained a goodwill clause.

Mr. G. FITZGERALD put further questions to witness, with a view to showing that the terms of the Bill would empower Bradford to take over the mains and pipes of the Drighlington Company without the word "undertaking" being included in the clause, which would imply that the purchase of a part of the Company's district would be at the price of old iron. The promoters were buying gas, and not property.

Re-examined, witness said that Bradford would pay for the goodwill in paying for the gas; the amount to be given to be fixed by arbitration. The tendency in Drighlington in the future would be for the gas supply to decrease rather than increase; the large millowners being more inclined to manufacture their own gas.

Mr. *W. C. Lupton*, Mayor of Bradford, who was the next witness, gave evidence as to the progress of the city; confirming in this respect the

opening statement of Counsel. The present Bill had received the assent of the Corporation practically with unanimity; and the view of the Corporation, had been confirmed at a public meeting. To his mind the objects of the Bill were good, and if carried into effect would tend largely to the benefit of the town.

Cross-examined by Mr. J. D. FITZGERALD, witness said that the Bill would complete a scheme which the people of Bradford had been for some years past anxious to see carried into effect.

By Mr. G. FITZGERALD: Cheaper gas was, no doubt, one of the inducements held out to the inhabitants of the districts included in the area of Bradford last year to give their consent.

Mr. *W. E. Aykroyd*, ex-Mayor of Bradford, and Deputy-Mayor and Chairman of the Gas Committee, gave evidence as to the extent and capabilities and limits of the gas undertaking of the Corporation. In making the purchase of the undertakings of the Companies, it was the desire of the Corporation that the Arbitrator should give a fair price. The arrangement proposed was a fair and reasonable one.

Cross-examined by Mr. J. D. FITZGERALD: The Thornton and Airedale District Councils might have been in opposition to the Bradford extension proposals of last year; but he could not say of his own knowledge. Counsel might put it that the opposition of these districts was bought off by the promise of the present Bill.

By Mr. G. FITZGERALD: We propose that we should pay your clients a statutory price for a statutory quantity of a commodity, and make no allowance for prospective profits.

Mr. FREEMAN: The prospective profits will be considered in the price.

Mr. G. FITZGERALD: Do you mind putting it in the Bill?

Mr. FREEMAN: It is in.

Mr. G. FITZGERALD: Tell me where. I can only find open arbitration?

Mr. FREEMAN: If my friend can prove that he has prospective profits, he will get them from the Arbitrator; but I cannot put prospective profits in the Bill if they are not proved to exist.

Mr. G. FITZGERALD: Do you concede the principle of prospective profits?

Mr. FREEMAN: If you prove that you have them, and there is nothing on the other side to go against them, undoubtedly the Arbitrator will take them into consideration. I have never known a case where prospective profits have not been brought in.

Mr. G. FITZGERALD maintained that, unless specific words were put in the Bill on this point, prospective profits would not be secured.

The CHAIRMAN: I should be glad if you would give us more general reasons for treating the Drighlington area in a different manner to the other four areas. It is admitted that the proposal of the Bill is almost, if not entirely, without precedent. We are, therefore, bound to go into the matter carefully.

*Witness:* In the Drighlington case, we do not take the whole of the supply; but we do so, speaking generally, in the other cases. If we took the whole of the Drighlington Company, we should overlap with the outside districts.

Clayton is very similar to Drighlington in this respect?—Yes; but there has been some willingness shown by Clayton to sell. They have negotiated with us for sale; the scheme failing on a question of price. But there has been no negotiation with Drighlington.

Mr. *Charles Wood*, of the Bradford Gas-Works, who was the next witness, said he had been two years in his present position. In 1899, the gas supplied by Bradford for private consumption and for public lighting was 1687 million cubic feet. The Companies supplied 265 million feet. He held that it was inconvenient in the area of the Corporation that another authority should have power to break up the streets. As to the capital expenditure of the Companies compared with the quantity of gas sold, he said that it was very high. The leakage had been very heavy also, except, perhaps, in the case of the Clayton Company.

Mr. WAUGH: Is there any prospect of the private consumers in these outside districts getting gas at the price at which it is sold by Bradford, if this Bill does not pass?

*Witness:* No. The price of gas in these districts is very high, having regard to the proximity of the coal mines. The Companies have large capital, and large areas to cover. The increase in the gas supply in these districts as a rule is not great; but in 1899 it was large, owing to the improved condition of trade. The extensions of the city boundary, which came into force last year, would also affect the increase.

With the exception of Huddersfield, do you know any instance in which a Gas Company have power to supply gas within the area supplied by the Corporation itself?—No. The Companies will be disappointed if the Bill does not pass. Their only object in coming here is to obtain as high a price as possible.

### Thursday, April 5.

Mr. *Wood*, in further examination by Mr. WAUGH, stated, with regard to the proposal to purchase gas in bulk from the Drighlington Company, that the Company would suffer no loss. They would obtain their price for the gas as fixed by arbitration, and would have one large consumer in perpetuity. They would not have any loss in collection or leakage through mains; and they would be able to maintain the whole of their present plant effectively in work. The price charged by the Company for gas was 2s. 7d. per 1000 cubic feet, or 6d. more than was charged by the Bradford Corporation. One-third of the houses in the Drighlington district did not take gas; and he therefore considered that the proposal of the Corporation would result in a large additional business to the Company.

Before witness was cross-examined, permission was given by the Committee for the interpolation of the evidence of Mr. Corbet Woodall, in order that he might be able to fill another engagement elsewhere.

Mr. *Corbet Woodall*, examined by Mr. WAUGH, said that he had visited Bradford and inspected the gas-works, and had also made himself acquainted with the districts supplied by the outlying Companies. In 1871, the Corporation purchased the gas-works supplying a portion of the borough; but since that time, the area of the borough had been further extended so as to include various other districts. The four Companies which it was proposed to purchase mainly derived their revenues from within the borough. They were not large concerns; their total consumption being 210 million feet, as against the sale by Bradford of nearly 1700 million feet. It was hardly possible for these small Companies to supply at the same rate as one large undertaking. If the illuminating power sent out by these Companies was raised to the same as that of Bradford, it would entail an increase in price. If the Bill passed, the price for gas would be made equal throughout the city, which would result in a saving to the consumers in the Clayton district of £1475, in North Bierley of £3189, in Eccleshill of £1062, and in Airedale of £1665—a total of about £7500. He thought that in the immediate future the acquisition of these Companies would cast a burden upon the present consumers of gas in Bradford—that was to say, after the Corporation had purchased the undertakings, abolished the existing gas-works, and built new ones to take their place, the charges would be greater. But as against this, there would be the benefit to the whole district of having the gas supply under the Local Authority, who would then have complete control over all the streets. Furthermore, the consumers in the districts would have the advantage of a reduction equal to the loss that the City of Bradford proper would have to bear. This loss would exist only for a short time, because greater economy would result from the undertakings being in one hand. The difference between interest on capital for Bradford and dividends and interest paid by the Companies, would represent about 16d. per 1000 cubic feet, or, on the total amount of gas sold by the Companies, £11,079. The Companies paid dividends totalling £14,867; and the Corporation interest on capital to do the same amount of business would be £3788. He did not see that any financial advantage would accrue to the Bradford Corporation upon the business at present done, as he had no doubt, when the undertakings were purchased, the Arbitrator would award such a sum as would absorb the whole of the profits to be made by the transfer. The amount of capital per million feet of gas sold in Clayton was £733, in Eccleshill £855, in North Bierley £872, in Airedale £911, and in Bradford £390. Among the circumstances which would make the transaction somewhat burdensome to the Corporation, were that they would be saddled by these amounts of capital; the immediate reduction in price; and the fact that three out of the four works would have to be abandoned, and there would be large expenditure in replacing them. There would be no loss to the shareholders in the transaction; while the Corporation would have the advantage of a growing business from the various undertakings, the demand for gas would be stimulated by the lower price, and the consumers would at once enjoy a large reduction in price. Of course, ratepayers consumed gas much more readily when they knew that the profits went into their own pockets as ratepayers; and the cost of manufacture and charges for interest would be greatly reduced. Asked to differentiate between the four Companies and the Drighlington Company, witness said that in the latter case a large area of the Company's district of supply, in which a very considerable portion of the business was done, was outside the City of Bradford. So far as he was aware, there was no Local Authority in a position to take over the outside portion from Bradford; but, for his own part, if the Drighlington Company would be willing to sell the whole, he saw no reason why Bradford should not take it, and continue to supply the district outside until the Local Authority could take it over. In regard to the arbitration clause, he thought the words, "future profits shall be taken into account," would prevent any injustice being done to the Company.

Cross-examined by Mr. J. D. FITZGERALD, witness said that he had never given evidence in favour of the compulsory expropriation of gas companies, and knew of no precedent for the present case.

Mr. FITZGERALD: Then it follows, from those two answers, that you are not in favour of the proposals of this Bill?

*Witness:* I object to the conclusion at which you arrive. I believe these are not compulsory transfers, in the true sense of the term. The Companies are here in the interests of their shareholders, in order to secure that a full price should be given for the undertakings. There have been negotiations with the Companies; and if the price had been satisfactory, they would not be before the Committee. Continuing, witness said he gave evidence against the proposal of the Bradford Corporation last year to compulsorily acquire the Pudsey Company. That proposal he believed to be injurious to the Pudsey Company. In regard to the Clayton case, there had been no complaint; and the Company were supplying 16½-candle gas when they were only compelled to supply 15 candles.

Cross-examined by Mr. BAGGALLAY, witness said that there were no complaints about the quality of the Eccleshill gas, or of the manner in which the undertaking was carried on. In that case, he had not heard of any negotiations with the Company.

Mr. BAGGALLAY: Do you think it a fair thing that a company who have not yet worked up to the payment of the dividends authorized by statute, and not at the end of their tether with regard to the expenditure of capital, should be compulsorily purchased?

*Witness* replied that he saw nothing in such circumstances to make a case against the purchase.

Mr. BAGGALLAY: Have you not often contended that a company ought to be allowed an opportunity of working up to their maximum dividends before the question of purchase is entertained, unless there are serious complaints against them?

*Witness* said he had always contended that it was harder for a company to be required to part with their undertaking against their will; but the case of a company who had not reached their full dividends, or expended their capital, would be dealt with by the Arbitrator. With regard to Drighlington, if the Committee were satisfied that the effect of the Corporation proposal would be indirectly to compel the Company to part with a portion of their undertaking, he would say this would be unfair. The price for gas taken in bulk should not be fixed once for all, but should be subject to revision from time to time.

Replying to questions by Mr. M'KENNA, witness said he did not agree with the statement of Mr. Balfour Browne that there were dozens of cases of statutory companies being taken over against their will. The Loughborough case was the only one he knew of; and to this extent he must qualify his previous statement that he knew of no precedent. When a company had actually entered into negotiations—as in the Morley and some other cases—then he thought the corporation had a right to come to Parliament, and say: "We cannot find terms to satisfy them; and we ask you to give us the right to go before an impartial tribunal to settle them."

Mr. *Chas. Wood* was then recalled for cross-examination. In reply to

Mr. J. D. FITZGERALD, he said he considered the price of Clayton gas was low, bearing in mind the circumstances, and the fact that the leakage was not extravagant.

The CHAIRMAN (interrupting) said he would make a suggestion which he thought might curtail the length of the proceedings. There was no allegation on the part of the Bradford Corporation that the gas supplied by the Companies was bad—or, indeed, any allegation of misfeasance of any kind. But they put forward their proposals on large grounds of public policy—that it was desirable as far as possible that the Corporation should obtain control of the gas made within their area, in order to prevent the streets being unnecessarily broken up, and so on. This being the case, he thought it wholly unnecessary to take up the time of the Committee by dealing with the quality of the gas supplied by the Companies. Counsel should, as far as possible, concentrate their cross-examination on points which were in dispute.

Cross-examination continued: He made no charge against the Companies that they had not done the best they could in meeting the wishes of the Corporation with regard to the breaking up of the streets; but with the tramway extension, this question would become more serious in the future, if the gas-pipes remained the property of the Companies. Beyond the fact that there were negotiations in 1897, which were broken off, he had nothing to show that the Clayton Company were willing sellers. Last year, the Corporation asked them if they were prepared to sell gas in bulk, and this year to negotiate a sale of the undertaking; but in each case the Company gave a refusal.

Mr. J. D. FITZGERALD: The fact is that the Corporation of Bradford are anxious to buy at the present time, when they would have to give less money than if the Company were paying maximum dividends.

*Witness* said he did not think that was the object. The Company had been paying a higher dividend than at present; and there was no proof that the dividends might not decrease instead of increase.

Replying to Mr. WEDDERBURN, witness said he did not think there would be any profit to the Corporation from the outside districts for many years. There would probably be a loss; but this would be compensated for by the gain to the city generally.

In answer to Mr. G. FITZGERALD, witness said that they were not proposing to take from the Drighlington Company their most lucrative district. The part of the area they were taking was away from the works, and there was extra cost for distribution.

Cross-examined by Mr. MOON: He had not heard of any negotiations with the Airedale Company which would indicate that they were willing sellers. He understood that they had been asked if they were prepared to sell their undertaking, and that they said "No."

In reply to Mr. LANKESTER, witness said that they did not propose to supply consumers outside the borough at the same price as those inside; but they would have the same limit that the Companies now had. In North Bierley, the maximum was 4s., and the charge 2s. 11d. It seemed to him that it would be very unfair to the consumers in the city that they should be called upon to pay part of the cost of the gas for those outside.

Mr. *E. Herbert Stevenson* said he knew Bradford and the neighbourhood very well. He had inspected the whole of the gas-works, with the exception of the Drighlington and Gildersome works, where he did not get permission to do so. The proposal was to purchase four Gas Companies. Of these four, Eccleshill was entirely within the borough, and Airedale was almost all within it; and both the districts served by these Companies were intimately connected with Bradford. In his opinion, it would be greatly to the advantage of the inhabitants if they were served with gas by a central authority. He had inspected the works of the two Companies he had mentioned; and in his view it would be impossible for them, for many years to come, to supply gas at the same rate as Bradford. Indeed, none of the districts around Bradford could do so. Such prosperity as the Companies had enjoyed in the past was due to their vicinity to the borough. The shareholders in the Companies would suffer no loss by arbitration. With two exceptions, in every case the purchase of gas undertakings by local authorities had been to the advantage of the shareholders, because they had received a sum that they could invest in other securities of a similar nature, and get a larger interest; and he was perfectly certain this would be the case in the present instance. The North Bierley Gas-Works were the only ones out of the five that were in a good condition. They were modern and well designed. It was true that some portion of the district served by the Company was outside the city boundaries; but there was not much consumption of gas. In the case of this Company, the only question at issue was the price of purchase. He had considered the case of the Clayton, Allerton, and Thornton Gas Company, and the district they served; and here the only solution of the question was to purchase the undertaking. He was quite willing to advise the selling of outlying portions to Local Authorities, such as the Wilsden District Council. He could see no difficulty that could possibly arise in arriving at a proper purchase-price for the undertakings. As the Companies managed their business at the present time, he did not think it was possible for them to pay their maximum dividend. He did not believe that, with the present price of coal, companies would be able to keep up the dividends which they were now paying. The Drighlington and Gildersome Company supplied Tong—perhaps the most valuable portion of their area—and the population of Tong was entirely an overflow from the borough. The great advantage of the scheme would be that the supply would be distributed to one consumer; and Bradford undertook to take a quantity of gas more than they would actually require. The proposals of the Bill would in no way increase the cost of gas to the consumers in the other districts. The Drighlington Gas-Works were in a bad condition, and were not capable of coping with the increase which might arise a few years hence. As the Corporation had the greater part of the gas supply in their district, he thought it was only reasonable and right that the remainder should be given to them. He knew several instances of statutory gas companies being compulsorily purchased against their will. They were not uncommon. They dated from 1869. The most recent cases were: The Ilkley Bill of 1893. The Chesterfield Gas and Water Bill of 1895, which was a little different. Skipton was, and was not in a way, a compulsory purchase. The Bill was brought into Parliament for the compulsory acquisition of the works. He acted for the Company; and during the progress of the Bill he obtained very favourable terms from the Corporation. Thereupon he advised the Company to settle on the Corporation's terms; and they did so. Stourbridge and Morley were also cases of compulsory purchase of gas undertakings.

Cross-examined by Mr. BAGGALLAY: With regard to the portions to be resold to the outside Local Authorities, there was no reason why they should not pay for them a price based on the amount awarded to the Companies.

Cross-examined by Mr. FITZGERALD, witness said that the Bradford Corporation had received authority from Parliament to supply the old borough, and had supplied nine-tenths of the gas now consumed in the present city area; and therefore they ought to be permitted to supply the remainder.

In reply to Mr. WEDDERBURN, witness would not say that the purchase-price to be awarded by the Arbitrator would be so great as to give each shareholder on re-investment an interest equal to 3 per cent. The capital of these Companies was not worth 3 per cent. The Companies, as a matter of fact, were asking a price equal to first-class debentures, which they were not entitled to.

Questioned by Mr. M'KENNA, witness said he knew of no instance since 1869 where the undertaking of a statutory gas company had been purchased compulsorily. There had been many water cases.

### Friday, April 6.

Mr. *W. A. Valon* said that, in his view, it would be a great advantage to Bradford to acquire the proposed undertakings, and it would not be any disadvantage to the shareholders. He attached considerable importance to the control of the breaking up of streets being in one hand. There was at present some complaint or dissatisfaction among the consumers of the Companies' gas, from the fact that they had to pay more than those who belonged to the city proper before the extension; and this could only be removed in one way—by purchase. For the Bierley district to be allowed to re-purchase the portion of the undertaking outside the city at the value of the pipes, would be manifestly unfair, as the Corporation would have to buy the whole thing as a going concern, and to pay its full commercial value. In the case of that district, there would be hardly any pipes; and so the outside district would practically get their portion of the undertaking for nothing. With regard to the Drighlington Company, it was proposed that the Arbitrator should settle the price per 1000 cubic feet to be paid by the Corporation, and the Arbitrator would take into consideration any future profits that the Company might likely make by the expansion of the district. The fact of the unexpended capital of the Company, amounting to £12,000, would also necessarily be taken into consideration by the Arbitrator. It would be perfectly easy for the Arbitrator to fix a price which would give the Company credit for all their future assets. The price should not be fixed once for all, but should be liable to periodical revision.

By Mr. BAGGALLAY: The sale of the Drighlington Company was about 51 million cubic feet; and the price charged was 2s. 7d. per 1000 cubic feet. In the United Kingdom, there were 440 gas companies.

Mr. BAGGALLAY: Are you aware that, out of the 440 companies, there are only 41 who charge so low a price as the Drighlington Company?

*Witness:* I daresay that is true; but it does not prove anything.

And do you know that there is no company doing so small a business as 51 million feet who sell at so low a price?—That may be so.

Mr. *Charles Hunt* also gave evidence in support of the Bill. He had had large experience in arbitrations, and had found that where companies were in good condition, and doing good trade, they received full value for their undertakings, with some allowance for compulsory purchase. With regard to the sale in bulk by the Drighlington Company, there would be no difficulty in revising the price from time to time; but it would be unwise to have a too frequent revision. Nor would there be any difficulty in arriving at a price which would take into account future development. Under the circumstances, he thought the proposals of the Bill fair and reasonable.

Cross-examined by Mr. J. D. FITZGERALD, witness said that the Birmingham Gas-Works, of which he was Engineer, were Corporation property, and were acquired by agreement.

This being the close of the promoters' case, the Committee consulted in private. On the re-admission of the public,

The CHAIRMAN said: The Committee cannot help thinking that, with regard to the matters dealt with in the gas clauses of the Bill, the parties might come to terms of agreement; and this being their opinion, they have decided to reserve the further consideration of the subject, and not to proceed with the evidence on this part of the Bill until the meeting of Parliament after the Easter holidays, so as to give full time to all the parties to consider the situation, and in the hope that something definite may be put before us.

Mr. FREEMAN: We have already come to terms with North Bierley.

The CHAIRMAN: I am very glad to hear it.

Mr. FREEMAN: And I think it is not improbable that the same course will be followed with the others.

The Committee then proceeded with other portions of the Bill, and at the close of the sitting adjourned till after Easter.

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**River Plate Gas Company, Limited.**—The report of this Company for the past year shows a profit of £89,326, to which has been added transfer fees, interest, commissions, &c., profit remittances, and the amount brought forward; making a total of £102,294. After payment of fixed charges, making ample allowance for bad and doubtful debts, and providing fully for the upkeep of the works, mains, &c., there remains to be dealt with the sum of £81,917. The Directors recommend that £10,000 should be added to the reserve (raising it to £50,000) and £2000 written off discount on the issue of debenture stock. A final dividend at the rate of 8s. per share, making 7 per cent. for the year (free of income-tax), is proposed; leaving £10,342 to be carried forward. During the year, the sum of £20,636 was spent out of revenue on the upkeep of works and mains, &c. A complete installation for the manufacture of carburetted water gas has been contracted for, and the greater part of the material is now on its way to Buenos Ayres. To provide a site for it, and for other extensions at the Corrales works, freehold property consisting of about 11,000 square metres, adjoining the works, has been purchased, as well as 11,116 square metres of land adjoining the Belgrano works. During the past year, the mains were increased by about 13½ miles, and 1995 new house services were connected.

# MISCELLANEOUS NEWS.

## HORSFORTH WATER-WORKS ARBITRATION.

**Saturday, March 24.**

(*Before Mr.* R. E. MIDDLETON, *Umpire.*)

This was an arbitration to decide the amount to be paid by the Horsforth Urban District Council for the undertaking of the Horsforth Water-Works Company, under an Act obtained last year. The proceedings took place at the Surveyors' Institution, London. Mr. R. E. PRESTON was Arbitrator for the Company; Mr. J. M. FAWCETT for the Council. Mr. PEMBER, Q.C., and Mr. R. A. SHEPHERD appeared for the Company; Mr. BALFOUR BROWNE, Q.C., and Mr. A. W. BAIRSTOW for the Council.

Mr. PEMBER, in opening the case, said the proceedings were taken under section 6 of the Act of last year, which provided that within six months of the passing of the measure the Council should purchase the water-works under the Lands Clauses Act. The Incorporating Act of the Company (which he believed had been in existence before the incorporation) was passed in 1865. The capital was then £8000 in shares, with borrowing power of £2000. The following year they obtained leave to raise £4000 in shares with £500 in debentures. The dividend on this capital was not limited; and they could distribute 10 per cent. In 1885, the Company again went to Parliament, and obtained powers to raise further capital of £15,000—viz., £12,000 in shares and £3000 in debentures—the interest on these shares being limited to 6½ per cent. The authorized capital of the Company was thus £29,500, but all had not been issued. Under the Act of 1865, the charge for water had been on the basis of the poor-law assessment; but in 1885, this had been altered, and the Company obtained power to lay the charge on the gross estimated rental—the charge being limited to 10 per cent. on rentals of £10 per annum and under, and 7½ per cent. on rentals above £10. In 1899, the Company went to Parliament for the acquisition of certain new streams; but they were met with the opposition of the Burley and Horsforth Urban District Councils. The result was that Parliament granted Burley their Bill, and gave the Horsforth Council power to purchase the undertaking of the Company and to borrow £60,000 for this purpose, the expenses of the Act, and the extension of the works and mains. At one time, the Company had some trouble in avoiding pollution; but at considerable expense they had overcome the difficulty, and the quality of the water was now unexceptionable. As to quantity, in 1897 the resources of the Company were severely taxed; and the Directors then made arrangements with the Yeadon Company by which they were enabled to purchase water in bulk at a cost of 6d. per 1000 gallons, with a minimum payment of £150 per annum. The gathering-ground of the Horsforth supply varied in height from 550 to 725 feet above sea-level; and the area could supply 160,000 gallons a day. There was no trade supply, and no manufactories of importance. There were 6517 consumers last year, and the number was increasing at the rate of 130 or 140 a year. The income last year was £1800; and this had, on the average, increased at the rate of £67 per annum, while the cost of working had for the last three years averaged £400 per annum. The income would, the Company anticipated, be materially increased by the re-valuation of the district, which was imminent. The present valuation was of very old standing; and the gross estimated rental on which the Company charged was nearly £300 below the income-tax valuation. The learned Counsel concluded by urging that the stability of the undertaking, its resources, and its increasing income should be considered in estimating the value.

Mr. BALFOUR BROWNE remarked that there was one mistake in the opening of his learned friend. He had stated that the available supply was 160,000 gallons per day; but this was before the compensation water was deducted.

Mr. PEMBER said he had been mistaken. He found that the total supply was estimated at 160,000 gallons a day; and from this would have to be deducted 42,600 gallons of compensation water. This would leave an available supply of 117,400 gallons daily, or an average of 18 gallons per head.

Evidence was then given on behalf of the Company.

Mr. *John Davis*, Clerk to the Commissioners of Property-Tax for the district of Skyrack, was called to prove that the gross estimated rental of Horsforth was set down in the rate-book at £18,749 14s., whereas the valuation for income-tax was £21,095.

Mr. BALFOUR BROWNE said they had nothing to do with the income-tax assessment. All they had to do with was the gross estimated rental at the time of the valuation. This was laid down in the Act of Parliament, and they could not go beyond it.

Mr. PEMBER replied that they had the right to give evidence that a re-valuation would lead to a large increase in their income.

The UMPIRE decided that the evidence was admissible.

*Witness* (continuing) gave instances of the discrepancy in rating, and said on the income-tax basis the revenue of the Company would be increased by £291 per annum.

In cross-examination, witness said he knew the basis of the poor-law rating was the rent that might reasonably be expected from year to year. This might vary from the rent that was paid.

Mr. *H. C. Blackburn*, Chartered Accountant, of Leeds, said he had examined the accounts of the Horsforth Water Company. The capital issued was £26,140, of which £21,200 was in shares and £4940 in loans. There had been expended on capital account £26,682 8s. 1d.—making the capital expenditure £522 8s. 1d. above the amount issued. The cost of the land and compensation was £2262 7s. 5d., reservoirs £10,184 10s. 9d., filter-beds £3881 16s. 3d., mains and pipes £6484 16s., and parliamentary expenses £5315 4s. 4d. The income for the past year had been £1800 18s. It had increased annually, and especially during the last six years. The population of the district was 7600; but of these 1083 were not using the Company's water. The number of houses supplied was 1541. The sum of £156 had been paid to the Yeadon Water Company last year for water supplied in bulk. If the water-rentals were charged on the full value, there would be an increased annual revenue of £291 0s. 6d.

Cross-examined, witness said the cost of the Bill they failed to obtain last year was charged to capital. The rateable value of the works of the Company was £535.

Mr. BALFOUR BROWNE: You would not like to be bought on that basis, would you?

Mr. PEMBER: No. That is why we say the rating is too low.

In re-examination, witness said £1232 had been spent on renewals—an average of above £43 a year.

Mr. *Charles Roberts*, Secretary of the Company, put in the correspondence with the District Council and tables showing the present consumers and the hours of supply. In 1885, they carried out various new works authorized by their Act of that year; and in 1895, under the advice of Dr. Bruce Low, of the Local Government Board, they added two new filter-beds and a pure-water tank. At the same time they made arrangements to prevent any pollution of the supply, and to carry the storm waters into the compensation reservoir.

In cross-examination, witness admitted that when Dr. Low, in 1895, examined the works, he condemned the condition of the gathering-ground. He found then several cases of pollution, and the sources slightly impure. The Company carried out certain works to improve the quality of the water. The gathering-ground was principally grazing land; only two fields were arable. In 1897, if they had not obtained the water from Yeadon, they would have had to put their consumers on short commons. When they went to Parliament last year, they proposed to get a supply from Burley Moor, but were unsuccessful. As to the age of the mains, three or four miles out of the fourteen or fifteen miles were laid in 1865. The gathering-ground comprised an area of 215 acres, the annual rent of which was about £200.

Mr. *A. J. Johnson*, Civil Engineer, of Bradford, said he knew the works of the Company. He had carried out many extensions of the works during the last few years. The Company had an upper reservoir with a capacity of 8 million gallons; a lower reservoir holding 26½ million gallons; and a compensation reservoir of 8 million gallons. Besides these, there were six filters and two pure-water tanks. As to the supply, he estimated the rainfall of the district at 34 inches per annum. Deducting one-fifth, and making an allowance of 15 inches for evaporation and absorption, they could rely on getting a rainfall of 12 inches, which, over the 215 acres of gathering-ground, would produce 160,000 gallons a day. From this had to be deducted 42,600 gallons compensation water; leaving 117,400 gallons daily supply available for Horsforth. This was equal to 18 gallons per head. He had no doubt there was an ample supply of water for the district, and sufficient reservoir accommodation. The lowest part of the district was 200 feet above sea-level, and the highest built upon about 525 feet. They supplied the Ida Hospital, which was in the Leeds area but could not be supplied by that town. This hospital took 405,000 gallons last year. Since the reservoirs were filled in 1897 and 1898, they had taken only the minimum supply from Yeadon. It was against his advice that the agreement with Yeadon was entered into. But at that time Dr. Bruce Low was in the town; and he wished to have an assurance that the Directors could obtain a supply of water. In 1895, a large sum was spent on renewals and services, the whole cost of which had been paid out of revenue. The works, including the reservoirs, filter-beds, and tanks, were in very good condition, and equal to any emergency. In his opinion, there need be no immediate expenditure on the plant, except the ordinary up-keep. There were about 1000 people not supplied with the Company's water. Most of these lived in farmhouses and had their own wells; the rest were small houses near the Town Well. Witness then gave his valuation of the undertaking. He took the gross income for 1899 as £1818, to which he added 10 per cent. for the anticipated increase on the new valuation—making a total revenue of (say) £1980. From this, he deducted the cost of working, rates, and taxes £400, leaving a net revenue of £1580. This he capitalized, at 33⅓ years' purchase, as £52,660. Deducting from this sum £450 liability for three years to Yeadon, and £1050 (being 5 per cent. on a capital expenditure of £21,000) for general depreciation of works, he arrived at £51,160 as the value, to which he added the usual 10 per cent. for compulsory sale, making a total of £56,276. This was his valuation of the property.

Cross-examined: He had advised the Company that, if they looked after the fittings and so reduced the leakage, there would be no need to obtain water from Yeadon; but they did not act on his advice. A good deal of the capital of the Company was held by Horsforth people. In his opinion, they might fairly have anticipated getting their maximum statutory dividend in a few years.

Mr. *Charles Gott*, Civil Engineer, of Bradford, said he had known the gathering-ground of the Company for many years. In his judgment, the rainfall of the district was not less than 34 inches. He had always taken that figure, and considered they could rely on 12 inches of rainfall over the 215 acres. This would give them, after deducting the necessary compensation water, 117,200 gallons a day. These calculations were based on an average of three dry years, so that in wet seasons they could obtain a good deal more. The reservoirs were of unusual capacity; and, in his opinion, the supply was practically secure. As to the mains, the only effective test of their soundness was the efficient supply of water to the consumers; and he had heard of no complaints. The mains buried in the ground would last for a very long time. He had himself taken up old mains which had been in the ground for forty years, and had relaid them as new ones. Since 1885, the Company had made great improvements in their works. New filter-beds had been constructed, and arrangements had been made to prevent fouling of the supply. The Company had carried out all their authorized works; but they had not spent all their authorized capital, and had been liberal in doing work out of revenue. In his view, their position was improving; and he anticipated that the statutory dividend of 10 per cent. might soon have been reached. Horsforth was a residential district of Leeds; and many Bradford people had lately gone there. He knew the arrangement under which the agreement with Yeadon was entered into. That year the Directors had to get more water; and the Yeadon supply was the only water they could obtain. The Yeadon people, having to lay mains, would not give the supply for only one year; so the Company had to make the agreement for five years. But he thought if the Directors looked after the waste, there was as much water in their own hands as the district required; and the agreement, therefore, need not be renewed. This arrangement, he considered, should not be taken into account in estimating the value of the undertaking—indeed, the contiguity of the Yeadon water might be reckoned as increasing the value of the Horsforth works. So far as he

could see, the earning power of the Company was not less than the present revenue. The income of £1800 was amply secured by the prospects of the Company. The local wells must gradually be abandoned, and the people take their supplies from the Company; and there must be an increased revenue consequent upon the adjustment and re-valuation of the township—an increase of income which would involve no extra expenditure. Witness then gave his valuation of the undertaking at £56,282, which concurred with, and was based on the same principle as, that of Mr. Johnson. In doing so, he pointed out that the income had increased on the average £69 4s. annually during the last three years, and that the works were in good order. There was no reason to expect any considerable expenditure on works for some time.

In cross-examination, witness said he had heard no complaints of the quality of the water, or of trouble from it freezing in the mains. The Company had not put aside any sum for depreciation. But this depreciation would be very small; and in his view the increasing value of the undertaking was a sufficient security for the maintenance of the revenue. The supply of 18 gallons per head in a residential district was quite sufficient—in fact it was more than was used.

### Saturday, March 31.

Mr. *C. J. Newstead*, Clerk of the Assessment Committee of the Wharfedale Union, said there were eight townships in the Union, and all had been re-valued except Ilkley and Horsforth.

Mr. *Samuel Wood*, one of the Overseers for the township of Horsforth, said there had been a rough re-valuation of the township begun; but it was not yet completed. So far as they had gone, some properties had been increased; but there was a "deal" on which there was no increase at all. All their assessments were subject to appeal; and till then nothing could be definitely known.

This concluded the evidence for the Company.

Mr. Balfour Browne then addressed the Umpires for the District Council. He said they were agreed as to the method of valuation. They were to find out the earning capacity of the undertaking; and that depended upon two or three things. The first consideration was, had the Company got the water required? because if it was bad in quality or insufficient in quantity, the income could not be said to be well secured. He made no attack on the gathering-ground. He would allow that, since Dr. Bruce Low reported, the Company had done something to stop the abominations which had existed. But it was admittedly difficult to keep a watershed like that pure. Then it was obvious, from their agreement with Yeadon, that the Company had not got a sufficient supply; and the payment of £405 in one year showed that the Horsforth Company were at the end of their tether. And besides this, the Company had last year applied to Parliament for power to get a new supply from Burley Moor. As to the rating, he contended that they had nothing to do with the income-tax assessment; all they had to consider was the gross value of the property at the present time. If the Company could have shown that the assessments had been increased, they might have claimed for the prospective value of such increase. But they could not do so; and all they had to go upon was the revenue they obtained—and obtained only by buying water from Yeadon. He urged that the income of the Company could not be said to be well secured. No one would consider it a 3 per cent. investment—indeed, the best water company in the world was not worth that. The depreciation was not nearly enough. The mains were old, and laid so near the surface that they were often frozen. As to the allowance of 10 per cent. for compulsory sale, the learned Counsel said this could only be claimed if the full value could not be measured. But in this case he urged the full value of the undertaking could be measured, so that no allowance should be claimed. There was nothing in the Lands Clauses Act to make it compulsory. There was no decision that held it to be a legal charge; and he appealed to the Umpire not to allow it.

The following evidence was then called.

Mr. *E. J. Silcock*, Civil Engineer, of Leeds, said he had known the district of the Horsforth water supply for many years. The description of the works given by the Company's witnesses was generally correct. He had examined the mains, and had samples of the worst and oldest. There were about four miles of these old mains which would require very shortly to be relaid, to put the system in a satisfactory state. These pipes were very old, and were laid too near the surface. This was not all that was necessary; but if these four miles were relaid, the system would be fairly satisfactory.

The Umpire: What is the size of the mains?

*Witness:* All are 3-inch and upwards.

Examination continued: There were in the district of supply about 700 acres which were at too high an elevation to be furnished with water by the Company; but the population of this area was only small. As to the gathering-ground, he accepted generally that this was 215 acres in extent. It was not an ideal gathering-ground; and the Company had already entered into agreements to secure some measure of control over the ground. The Company or the District Council might find it to their advantage in the future to purchase the lands, so as to secure full control. Leeds had gone to a great expense lately in purchasing the land in the gathering-ground of their water-works—especially the land near the river. He had examined the rainfall of the district; and he based his calculations on two gauges nearest to the gathering-ground—one at Oliver's Hill, and one at Lawns Wood Cemetery. The result was that he estimated the available rainfall at 11 inches, instead of 12 inches as calculated by Mr. Johnson. They had three consecutive dry years in 1897, 1898, and 1899; and he found the rainfall during these years was 23·92 inches. To this he added, for the difference in elevation between the gathering-ground and the gauges, 8·6 per cent., which would make the gross rainfall 26 inches. In this ground, he considered the loss from evaporation and percolation would not be less than 15 inches, which would leave the net amount available 11 inches. On the 215 acres, a fall of 11 inches would produce a daily flow of 146,630 gallons, or, deducting 42,600 gallons compensation water, a daily supply of 104,030 gallons available for the Company. A further addition had to be made, as the capacity of the reservoirs was greater than usual in relation to the extent of the gathering-ground. It was

## GAS AND WATER COMPANIES' STOCK AND SHARE LIST.

Referred to on p. 991.

| Issue. | Share | When ex-Dividend. | Dividend or Dividend & Bonus. | NAME. | Closing Prices. | Rise or Fall in Wk. | Yield upon Investment. | Issue. | Share. | When ex-Dividend. | Dividend or Dividend & Bonus. | NAME. | Closing Prices. | Rise or Fall in Wk. | Yield upon Investment. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| £ | | | p. c. | GAS COMPANIES. | | | £ s. d. | £ | | | p. c. | GAS COMPANIES. | | | £ s. d. |
| 590,000 | 10 | Apl. 11 | 10½ | Alliance & Dublin 10 p. c. | 20—21* | .. | 5 0 0 | 60,000 | 5 | Feb. 23 | 7 | Ottoman, Ltd. | 4¾—5¼ | .. | 6 13 4 |
| 100,000 | 10 | ,, | 7½ | Do. 7 p. c. | 13½—14½* | .. | 5 3 5 | 500,000 | 100 | Dec. 1 | 6 | People's Gas 2nd Mtg. of Chicago Bonds | 102—106 | .. | 5 13 2 |
| 800,000 | 100 | Jan. 2 | 5 | Australian 5 p. c. Deb. | 100—102 | .. | 4 18 0 | | | | | | | | |
| 200,000 | 5 | Nov. 15 | 6 | Bombay, Ltd. | 6¼—6¾ | .. | 4 8 11 | 851,070 | 10 | Oct. 13 | 7 | River Plate Ord. | 11½—11⅝ | .. | 5 19 2 |
| 40,000 | 5 | ,, | 6 | Do. New, £4 paid | 4½—4⅝ | .. | 5 1 1 | 250,000 | Stk. | Dec. 29 | 4 | Do. 4 p. c. Deb. | 100—102 | .. | 3 18 5 |
| 880,000 | Stk. | Feb. 23 | 12 | Brentford Consolidated | 255—265 | −5 | 4 10 7 | 250,000 | 10 | Apl. 11 | 8 | San Paulo, Ltd. | 11½—12⅝* | +½ | 6 8 0 |
| 270,000 | ,, | ,, | 9 | Do. New | 197—202 | −3 | 4 9 1 | 135,000 | Stk. | Sept. 15 | 10 | Sheffield A. | 249—251 | .. | 3 19 8 |
| 50,000 | ,, | ,, | 5 | Do. 5 p. c. Pref. | 140—145 | .. | 3 9 0 | 209,053 | ,, | ,, | 10 | Do. B. | 249—251 | .. | 3 19 8 |
| 159,375 | ,, | Dec. 14 | 4 | Do. 4 p. c. Deb. | 118—123 | .. | 3 5 1 | 447,427 | ,, | ,, | 10 | Do. C. | 249—251 | .. | 3 19 8 |
| 220,000 | Stk. | Mar. 14 | 11½ | Brighton & Hove Orig. | 287—242 | .. | 4 15 0 | 5,600,000 | Stk. | Feb. 23 | 5½ | South Metrop., 4 p.c. Ord. | 134—136 | −1 | 3 18 5 |
| 226,330 | ,, | ,, | 8½ | Do. A. Ord. Stk. | 180—185 | .. | 4 11 11 | 1,520,000 | ,, | Jan. 12 | 3 | Do. 3 p. c. Deb. | 100—102 | .. | 2 18 10 |
| 999,500 | Stk. | Feb. 23 | 5 | Bristol, 5 p. c. max. | 125—130 | .. | 3 16 11 | 380,940 | Stk. | Nov. 30 | 5 | Southampton Ord. | 117—122 | .. | 4 2 0 |
| 420,000 | 20 | Mar. 29 | 10 | British | 41½—42½ | .. | 4 13 0 | 70,825 | ,, | Dec. 29 | 4 | Do. 4 p.c. Deb. | 120—125 | .. | 3 4 0 |
| 50,000 | 10 | Feb. 23 | 12 | Bromley, Ord. 10 p. c. | 24—26 | .. | 4 12 4 | 120,000 | Stk. | Mar. 14 | 6 | Tottenham A. 5 p.c. and B. 3½ p.c. | 100—102 | .. | 4 8 3 |
| 70,000 | 10 | ,, | 9 | Do. 7 p. c. | 19—21 | .. | 4 5 8 | 250,520 | ,, | ,, | 4½ | | | | |
| 500,000 | 10 | Oct. 13 | 6 | Buenos Ayres (New) Ltd. | 9⅜—10¼ | .. | 5 17 1 | 55,100 | ,, | Dec. 14 | 4 | Edmonton 4 p. c. Deb. | 113—117 | .. | 3 8 5 |
| 220,000 | Stk. | Dec. 29 | 4 | Do. 4 p. c. Deb. | 99—101 | .. | 3 19 3 | 182,380 | 10 | Jan. 12 | 5 | Tuscan, Ltd. | 8—9 | .. | 5 11 1 |
| 150,000 | 20 | Mar. 14 | 8½ | Cagliari, Ltd. | 25—27 | .. | 6 2 3 | 149,900 | 10 | Jan. 2 | 5 | Do. 5 p. c. Deb. Red. | 101—104 | .. | 4 16 2 |
| 100,000 | 10 | Sept. 29 | 8 | Cape Town & Dis., Ltd. | 15—16 | −½ | 5 0 0 | | | | | | | | |
| 50,000 | 50 | Nov. 2 | 6 | Do. 6 p.c. 1st Mort. | 56—58 | .. | 5 3 5 | | | | | | | | |
| 550,000 | Stk. | Apl. 11 | 13½ | Commercial Old Stock | 295—300* | .. | 4 10 0 | | | | | | | | |
| 236,425 | ,, | ,, | 10½ | Do. New do. | 230—235* | .. | 4 9 4 | | | | | | | | |
| 288,237 | ,, | Dec. 14 | 4½ | Do. 4½ p. c. Deb. | 142—145 | .. | 3 2 1 | | | | | | | | |
| 800,000 | Stk. | Dec. 14 | 9 | Continental Union, Ltd. | 160—170 | +5 | 5 5 11 | | | | | | | | |
| 200,000 | ,, | ,, | 7 | Do. 7 p. c. Pref. | 175—180 | −3 | 3 17 9 | 780,399 | Stk. | Dec. 29 | 11 | WATER COMPANIES. Chelsea, Ord. | 307—312 | .. | 3 10 6 |
| 51,600 | Stk. | Feb. 23 | 14 | Croydon A 10 p. c. | 335—340 | .. | 4 2 4 | 150,000 | ,, | ,, | 5 | Do. 5 p. c. Pref. | 157—162 | .. | 3 1 9 |
| 173,400 | ,, | ,, | 11 | Do. B 7 p. c. | 265—270 | .. | 4 1 5 | 160,000 | ,, | ,, | 4½ | Do. 4½ p. c. Pref. '75 | 145—150 | .. | 3 0 0 |
| 555,000 | Stk. | Feb. 23 | 5½ | Crystal Palace Ord. 5 p.c. | 120—125 | −2 | 4 4 0 | 175,785 | ,, | Mar. 29 | 4½ | Do. 4½ p. c. Deb. | 145—150 | .. | 3 0 0 |
| 60,000 | ,, | ,, | 5 | Do. 5 p. c. Pref. | 130—135 | −2 | 3 14 1 | 1,720,560 | Stk. | Apl. 11 | 7 | East London, Ord. | 196—201* | −½ | 3 9 8 |
| 486,090 | 10 | Jan. 26 | 11 | European, Ltd. | 19½—20½ | .. | 5 7 4 | 654,740 | ,, | Dec. 29 | 4½ | Do. 4½ p. c. Deb. | 145—150 | .. | 3 0 0 |
| 854,060 | 10 | ,, | 11 | Do. £7 10s. paid | 15—16 | .. | 5 3 2 | 890,000 | ,, | ,, | 9 | Do. 3 p. c. Deb. | 99—101 | .. | 2 19 5 |
| 14,993,075 | Stk. | Feb. 9 | 4⅛ | Gas-light and Coke | 4 p. c. Ord. | .. | 4 14 2 | 700,000 | 50 | Dec. 14 | 7½ | Grand Junction 10 p. c. max. | 107—109 | .. | 3 8 10 |
| 2,600,000 | ,, | ,, | 3½ | | 3½ p. c. max. | .. | 3 10 8 | 310,000 | Stk. | Mar. 29 | 4 | | 130—135 | .. | 2 19 3 |
| 3,799,735 | ,, | ,, | 4 | | 4 p. c. Con. Pref. | .. | 3 5 7 | 708,000 | Stk. | Feb. 23 | 14 | Kent | 307—312 | .. | 4 9 9 |
| 3,993,975 | ,, | Dec. 14 | 3 | | 3 p. c. Con. Deb. | .. | 3 0 0 | 160,000 | ,, | ,, | 7 | Do. New, 7 p. c. max. | 200—210 | .. | 3 6 8 |
| 70,000 | 10 | Nov. 15 | 8 | Hongkong & China, Ltd. | 13¼—14½ | .. | 5 10 4 | 1,043,800 | 100 | Dec. 29 | 10½ | Lambeth, 10 p. c. max. | 295—300 | .. | 3 10 0 |
| 3,800,000 | Stk. | Nov. 15 | 10 | Imperial Continental | 211—214 | .. | 4 13 6 | 406,200 | 100 | ,, | 8 | Do. 7½ p. c. max. | 215—220 | .. | 3 12 9 |
| 478,600 | Stk. | Feb. 9 | 8½ | Do. 8½ p. c. Deb. Red. | 100—103 | .. | 3 8 0 | 350,000 | Stk. | Mar. 29 | 4 | Do. 4 p. c. Deb. | 130—133 | .. | 3 0 2 |
| 75,000 | 5 | Dec. 14 | 6 | Malta & Medn., Ltd. | 4½—5½ | .. | 5 9 1 | 500,000 | 100 | Feb. 23 | 13½ | New River, New Shares | 418—423 | .. | 3 3 9 |
| 560,000 | 100 | Apl. 2 | 5 | Met. of Melbourne 5 p. c. Deb. | 105—109 | −2 | 4 11 9 | 1,000,000 | Stk. | Jan. 26 | 4 | Do. 4 p. c. Deb. | 132—137 | .. | 2 18 5 |
| 250,000 | 100 | ,, | 4½ | | 105—107 | .. | 4 4 1 | 902,300 | Stk. | Dec. 14 | 7½ | South-wark Ord. | 200—205 | .. | 3 13 2 |
| 541,920 | 20 | Nov. 15 | 3 | Monte Video, Ltd. | 11—12 | .. | 5 0 0 | 126,500 | 100 | ,, | 7½ | | 190—195 | .. | 3 16 11 |
| 667,946 | Stk. | Feb. 23 | 9½ | Newc'tle & Gatesh'd Con. | 215—220 | .. | 4 4 1 | 489,200 | Stk. | ,, | 5 | and 5 p. c. Pref. | 160—165 | .. | 3 0 7 |
| 299,855 | Stk. | Dec. 29 | 8½ | Do. 8½ p. c. Deb. | 104—107 | .. | 3 5 5 | 1,019,585 | ,, | Apl. 11 | 4 | Vauxhall 4 p. c. A Deb. | 129—134* | .. | 2 19 9 |
| 150,000 | 5 | Nov. 30 | 8 | Oriental, Ltd. | 7—7½ | .. | 5 6 8 | 1,155,066 | Stk. | Dec. 14 | 10 | West Middlesex | 288—293 | .. | 3 8 3 |
| 135,000 | 5 | ,, | 8 | Do. New, £4 10s. pd. | 6½—6⅝ | .. | 5 6 8 | 200,000 | ,, | ,, | 4½ | Do. 4½ p. c. Deb. | 147—152 | .. | 2 19 3 |
| 15,000 | 5 | ,, | 8 | Do. do. 1879, £1 pd. | 1½—1⅝ | .. | 4 11 5 | 200,000 | ,, | Mar. 14 | 8 | Do. 8 p. c. Deb. | 99—101 | .. | 2 19 5 |
| | | | | * Ex div. | | | | | | | | | *Ex div. | | |

generally accepted that the storage should be equal to 25 days' supply, or (say) 33 million gallons; but the actual storage was 42 million gallons, which was an excess of 9 million gallons. This would add 8220 gallons daily to the supply, making a total of 112,250 gallons per day. In his opinion, the daily supply should be at least 20 gallons per head; so that the Company had only sufficient for 5612 persons out of the total of 6680 at present actually supplied. The inference was that the Company were enjoying an inflated income, for they were receiving water-rentals from a larger population than they could supply. This was proved also by the fact that the Company had only had a short supply in dry seasons; and in 1898 they had no water in their reservoirs. In 1897, the Company made an agreement with the Yeadon Water Company, which proved that they were incapable of supplying their population; and last year they had applied to Parliament for further powers. The present works, he considered, would not supply the population; and it was inevitable that they must be increased. The District Council, when they acquired the undertaking, would have to do this; and the burden would be far in excess of any present benefit derived from it. He should not consider any company well secured who had to go to another company to purchase water to carry out their statutory obligations. In his valuation, he had considered the question of the increased income anticipated by the re-valuation of the district. But, in his view, the difference would be very slight. The assessments at Horsforth were in excess of the other townships in the Union; and a great number of the houses had been built during the last ten or fifteen years, and were fully rated. It was only in the smaller and older property that there would be any increase. He had considered that the valuation should not be on the basis of the last year's income, because the income could be largely increased by the Company reducing their expenditure on maintenance; so he had taken as the basis of his valuation the revenue and expenditure for the last two years. The following was his valuation: Gross revenue: 1898, £1737; 1899, £1801. Working expenses: 1898, £839; 1899, £475. Bank interest: 1899, £47. Adding the payments made for Yeadon water (£405 in 1898, and £161 in 1899) left a net revenue of £1303 in 1898, and £1440 in 1899. The mean of two years' net profits, if the Company had sufficient water, would therefore be £1372. Discounting this in the ratio of 5612 (the number of people the Company's works could supply) to 6680 (the number of people, with the aid of the Yeadon water, actually supplied), left £1151 as the net revenue the works were capable of earning. At 22½ years' purchase, this would equal £25,898. To this must be added £195, profit on the Yeadon water for the period during which the agreement had to run, and 10 per cent. for compulsory sale, which would leave an amount of £28,702. But from this he deducted £1959 for expenditure on works immediately required, which would leave £26,743 as his valuation of the undertaking. He only gave 22½ years' purchase, because he thought this was all so badly secured an income was worth. To carry out their statutory obligations to supply the neighbourhood, the Company would have to incur considerable expenditure.

Cross-examined by Mr. PEMBER: He had valued two water companies; and in both cases he had taken 22½ years' purchase. One company obtained 22 years, and the other 27 years. When before Parliament last year, he had suggested a scheme for obtaining a further supply of water by pumping, which would only cost £7000 and yield up to 500,000 gallons a day. The water could be pumped for 4d. per 1000 gallons, if 100,000 gallons were pumped daily, or 2d. if 200,000 gallons were taken. The Company's mains which were defective were 2 and 3 inch ones, and could be renewed for about £396 a mile.

Re-examined: The number of years' purchase must depend upon the individual circumstances of each case; but he had never heard of a company who could not supply the necessary water obtaining such a sum as 33 years' purchase. If the Company had carried out their scheme of last year, and at their own estimate, the return on the capital would only be 2½ per cent.; and even if his plan were carried out, the cost would be £7000. In considering the rainfall, he personally thought the deduction of 15 inches for loss too low; but it was agreed on between Mr. Johnson and himself.

Mr. *E. M. Eaton* said he knew the Company's works and their drainage ground. He thought the area was slightly smaller than 215 acres; but he had taken that figure. As to the rainfalls, he had taken the rainfalls of the district by all the gauges which had been in existence for three dry years. It was usual to take from the normal rainfall one-fifth for the average of dry seasons. But as there were two gauges within a few miles of the reservoir, and as there had been three consecutive dry years in 1897, 1898, and 1899, he thought it far more accurate and reliable to take these actual gauges. The years named were not the three dryest years they could have chosen, so the estimate was rather over than under the mark. But taking these three years, he found that the rainfall had been at Oliver's Hill 20·12 inches in 1897, 29·36 inches in 1898, and 24·34 inches in 1899—or a mean of 24·61 inches. At Lawson's Wood, the rainfall in 1897 was 19·54 inches, in 1898 27·32 inches, and in 1899 22·84 inches—or a mean of 23 23 inches. Both gauges were at a lower level than the average of the gathering-ground. In a fairly undulating country like this, with no abrupt valley, it was usual to add 3 per cent. per 100 feet of elevation; so that 2·95 inches would have to be added to the Oliver's Hill gauge and 1·18 inches to the Lawson's Wood gauge. Thus adjusted, the gauges would be 27·56 and 24·41 inches respectively, or a mean of (say) 26 inches. If the three dryest years had been chosen, the figures would probably be reduced. The loss by evaporation and absorption would be not less than 15½ inches; but as 15 inches was the figure practically agreed and accepted, he had taken it, though he was quite satisfied that it was too small. Taking the area at 215 acres, there would be a daily flow of 146,630 gallons; or, deducting the 42,030 gallons compensation water, 104,600 gallons. He agreed that the capacity of the reservoirs was 9 million gallons more than the requirements; and this, spread over three years, would give 8220 gallons daily.

The UMPIRE asked why witness spread the 9 millions over three years.

*Witness* said this was the basis on which he always took it. The total population of the district was 7600. Those not supplied numbered 920; so that there were 6680 consumers, and the Company had only water for 5641 persons, or an average consumption of 20 gallons a day. The daily flow and the excess storage of the reservoirs would do that. The average


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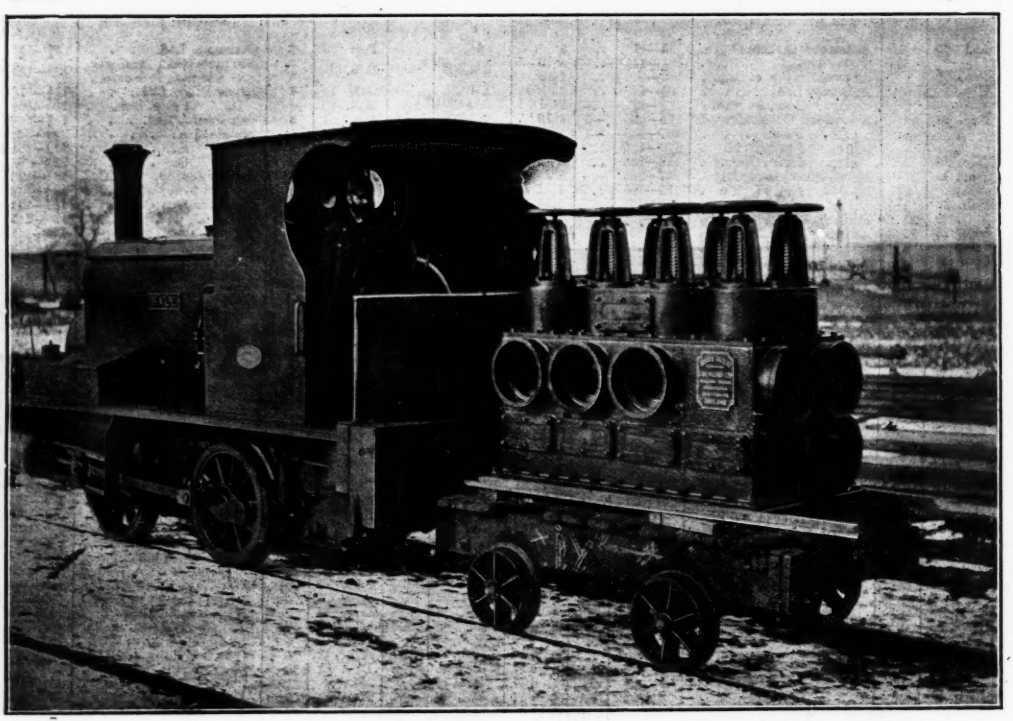

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of 20 gallons per day was an outside amount for a district like this, if the distributing pipes and mains had been in good condition; but many of the mains were old, and the loss from leakage would be considerable. That the Company could not do more, was shown by the arrangement they had made with Yeadon for a supply of water. But Yeadon would very shortly need all their water for themselves. He thought the agreement a very prudent one when it was made, because it was terminable; and before its termination the Yeadon Company would not be likely to need the water, and the payment by Horsforth would be found money to them. Witness then gave his valuation, which was made on the same basis as Mr. Silcock's. He found the mean of two years' net profits, if the Company had had sufficient water, to be £1372; but he discounted this in the ratio of 5641 (the population which could be supplied by the Company's works) to 6680 (the population actually supplied), which gave a net revenue earned by the Company's works of £1159. This, at 22½ years' purchase, would be worth £26,078. He gave only 22½ years, because the distributing mains of the Company were not perfect, and they were not able to supply from their own works the whole district. To this he added the three years' profit on the Yeadon water, £171, and 10 per cent. for compulsory sale—making a total of £28,874. But from this he deducted £2000 for repairs and renewals which were immediately necessary. The filter-beds and pure-water tanks were satisfactory, but the reservoir needed pointing and some small repairs to prevent waste, and the distributing apparatus greatly needed renewals.

Cross-examined by Mr. Pember: At Sheffield, he had been able to reduce the domestic supply to 13 or 13½ gallons per head per day.

Mr. Pember: I see, if we deduct the mortgage debt, you only allow us £21,934. That is making the shares below par. Would you consider that fair?

*Witness* thought it would be fair, if the Company had got below a par basis. He did not know that at the last sale the £10 shares had realized £18; but the market was very small, and there had been no sales for many years. The Harrogate Company obtained 36 years' purchase; but the conditions were very different from the present case. They had a large margin of revenue; and their works were in good order. This was proved by the fact that the Corporation now made a large profit from the undertaking. As to the Yeadon supply, their Engineer had not yet had a trial of three dry years with the new works.

Mr. Balfour Browne: And in the House, Mr. Gott's evidence was that Yeadon would not have any supply to spare in a few years.

In re-examination, witness said estimates of the rainfall were not always reliable; and they might have less water than they thought. It would, in all probability, cost £4000 to make the Company's distributing apparatus effective.

Mr. Balfour Browne said they had other evidence—the accountant and local witnesses—but he did not think it necessary to call them, as they did not dispute Mr. Blackburn's figures. In summing up, he said there were three points in dispute—What was the revenue? How was it secured? How had one to gauge the security? He contended that the revenue was not earned by the Company, but by the Company and the Yeadon agreement. The income could not be said to be secured; for the Company had often cut off the supply, and since 1898 had only kept up a constant supply by the aid of Yeadon water. As to the gathering-ground, he allowed that something had been done to regulate it; but the farmers might become lax; and they would have another stinging report from Dr. Lowe. The District Council, when they secured the works, had to contemplate an expenditure of at least £7000 to make the supply satisfactory; so that it was evident the undertaking could not be worth the estimate of the Company's witnesses. In conclusion, the learned Counsel repudiated altogether the income-tax valuation. He asked the Umpire, if he should add anything to the present income for any supposed prospective increase from the re-valuation, to give it as a special award, so that they might take the opinion of a Court of Law on the subject.

Mr. Pember briefly replied. He said all they had contended was that there was a presumption that the re-valuation would increase their water-rentals. As to the difference in the valuation, he urged that, even if it cost £2000 to put the mains and pipes in good condition, that would make no substantial difference in their estimate of the value of the Company's undertaking.

The proceedings then terminated; the Umpire reserving his award.

## GAS-WORKS IMPROVEMENTS AND EXTENSIONS AT WALSALL.

As the outcome of a report by Mr. Corbet Woodall on the condition of the gas-works and plant at Walsall, the Gas Committee yesterday week recommended the Town Council that ten beds of retorts be re-set, at an estimated cost of £3500, and that two additional purifiers and a washer-scrubber be constructed, at a further estimated cost of £6000. The Committee also proposed to consider the erection of a carburetted water-gas plant and a new retort-house. Mr. Brownhill explained that the £6000 was an expenditure which the Council had previously sanctioned, and for which a loan had been obtained. The £3500 would have to be paid out of current account; but as the Committee had originally estimated they would have to spend £5200, there was some cause for gratification. Mr. Powell complained that members of the Council were not taken into the Gas Committee's confidence, and knew very little of what was being done at the works. Alderman Holden took the same view, and thought the Council were not justified in sanctioning the expenditure of large sums without more information. Mr. Brownhill denied that the Committee had held back any information from the Council, and the recommendations were approved. The Committee's minutes also referred to the resignation of the Gas Engineer and Manager (Mr. W. Gorse), and recommended the appointment of a successor at a salary of £500 a year.

The Gas, Water, and Electricity Committee of the Leigh Town Council have referred to a Sub Committee estimates, prepared by the Gas Engineer, for extensions at the gas and electricity works; the total amounting to £13,500.


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## PROPOSED MECHANICAL STOKING AT THE SOUTHPORT GAS-WORKS.

It is intended to equip the Southport Gas-Works with mechanical stoking machinery; and therefore Dr. Isherwood, in moving the adoption of the minutes of the Gas Committee at the meeting of the Corporation last Tuesday, felt constrained to give the members some information on the question. He said the subject had two aspects—the financial and the humanitarian. If they looked at the financial aspect, it presented them with something like the following: Each man they had employed was able to carbonize 2 tons of coal in an eight-hour shift, for which he obtained 5s.; so that the carbonizing wages cost about 2s. 6d. per ton. With the machinery the carbonizing could be done for 1s. 2d. per ton; and it cost something like 3d. per ton more—3 per cent. on the outlay, and 5 per cent. on the wear and tear; leaving a profit of 1s. 1d. per ton. If they called it roughly 1s. per ton, it meant, on 34,000 tons, a saving of £1700. In his opinion, this would not be the only profit that would result from introducing mechanical stoking. The retorts would be charged more evenly and quicker. He also spoke of the improved conditions under which the men worked with stoking machinery. The difficulty he saw about the matter was the question of the men. At present they had 27 men in each of three shifts, working in eight-hour shifts; so that 81 men were engaged in the carbonizing department. With mechanical stoking, the work could be done by 15 men per shift, which would mean in three shifts a reduction of 36 men. The Committee felt that, if they could come before the Council and show them that by this change they would save something like £1700 or £1800 a year, they might expect the other Committees of the Corporation would assist them in finding every man work. Some of the speakers who followed Dr. Isherwood congratulated the Gas Committee upon taking this step; but Alderman Booth felt it was a serious question for the men. He was of opinion that the Committee should withdraw the report until they were satisfied the men who would be displaced could be engaged on some other work at a decent wage. He moved that the section of the minutes referring to the introduction of stoking machinery should be deleted. This was not seconded; and the minutes were adopted.

## THE INCREASE IN PRICE AT MIDDLESBROUGH.

The Middlesbrough Town Council, at their Meeting last Tuesday, discussed the proposals of the Gas Committee with reference to the raising of the price of the gas. Prior to the Council meeting, the Committee had decided to recommend the addition of 3d. per 1000 cubic feet to the price of gas for consumers within the borough, and 9d. increase outside the borough. This is extra to the recent increase of 2d. per 1000 cubic feet, and makes the price 3s. 3d. or 3s. 9d., with 10d. per 1000 feet discount if paid within a month. Mr. Baker objected to fixing the increase at this time of the year, and suggested waiting until the contracts for materials were made. They were given to understand in the estimate before them that £10,432 profit would be made in the year, making, with £1741 balance brought forward, about £12,000. Interest and redemption amounted to £11,750; and it was proposed to create a second or double redemption fund of £4000, called a reserve fund—making £15,750 to meet. This left a balance of £3750. They had been told that a penny increase per 1000 feet produced £2000; so that he thought a 2d. increase would meet their requirements. He questioned, however, the fairness of the estimated produce from the residuals. Last year the residuals had given back 65 per cent. of the cost of coal. Next year 50 per cent. would be a fair estimate, he thought; but he did not think the Accountant had given such credit. Coke had sold at 9s. per ton; and he felt sure that 13s. 4d. for the next year would be realized. Yet if only 3s. increase were noted, this would mean £3000 more. Alderman Bulmer said, although they had still a contract running for coal at 11s. per ton, their next contract could not be for less than 18s. 9d.; and it would be folly not to provide against it. Alderman Wilson, referring to the reserve fund being created, hailed it as a proper step, and hoped nothing would transpire to prevent them paying off capital as quickly as possible, and meeting the due interest and redemption. Alderman Hugh Bell concurred with the proposals for increasing the price. It had been assumed that coal would cost 17s., and the estimated cost of production at this moderate price was 2·8d. per 1000 feet. If they took Alderman Bulmer's figures of 18s. 9d., this would be 3·4d. per 1000 cubic feet. He agreed, however, that Mr. Baker's estimate of 50 per cent. return from residuals was very fair. But the position of the gas-works was a most awkward one. Originally, they borrowed on terms of repayment extending over 35 or 40 years. In 1877, they increased the period to 60 years—powers that were greatly in excess of what was reasonable. No gas plant had such a life. There was not a single stone left of the works of 1858, and even that with which they replaced the old works had since been pulled down and rebuilt. During the last 14 years, they had removed all the surface works then standing, although he did not say they would have to renew every 14 or 20 years. But to spread redemption over 60 years was wrong. By doubling the redemption fund, as Mr. Baker had termed it, they were reducing the term to 30 years. Had they gone further to make it 20 years, it would be well within the mark. The increases were confirmed.

## ELECTRIC LIGHTING NOTES.

The Electricity Committee of St. Pancras Vestry last Wednesday reported to that body that the total loans incurred in providing the electric lighting system of the parish amounted to £236,780, of which £17,246 had been repaid. The capital expenditure in 1899 was £47,915; making a total of £288,146. The gross revenue for the year reached £44,880; and the net profit was £6841. Adding to this a balance of £1892 from 1898, there was a total net profit of £8734. Writing off £1600 for depreciation, the Committee proposed that £2000 be appropriated as a contribution to the lighting rate; that £4000 be transferred

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to the reserve account; and that the balance—£1134—be carried forward. Further, having regard to these satisfactory results, the Committee recommended that, after the next June quarter, the price for supplying the public lamps should be reduced from 4d. to 3d. per unit; the price to consumers not using the maximum demand indicator from 6d. to 5d. per unit; the price to consumers using this indicator from 6d. per unit for the first 1½ hours and 3d. per unit afterwards, to 6d. per unit for the first hour and 2d. per unit afterwards. At the same time the Committee recommended that the price to consumers requiring a supply for motive power, heating, &c., should be reduced from 3d. to 2d. per unit. The reductions recommended were to apply only to those supplied at 220 volts, and also to parties who were willing to change from 110 volts to this pressure when required by the Vestry. Dr. Walter Smith, in moving the adoption of the Commitee's report, stated that during the nine years the electric supply of the parish had been in the hands of the Vestry, they had made a net profit on the undertaking of £34,980. The motion was adopted.

On Wednesday, the 4th inst., Colonel J. T. Marsh, R.E., held an inquiry, on behalf of the Local Government Board, into an application by the Farnworth District Council for power to borrow £22,000 for electric lighting and traction purposes. Among those in attendance were the Assistant-Clerk (Mr. W. Tyldsley), the Engineer (Mr. Lacy), and the Architect (Mr. Stone). From the statements made by these gentlemen, who put in various plans, the generating station is intended to be built on some freehold land belonging to the District Council, the site measuring about 1570 square yards. There are to be three dynamos, each with a capacity of 120 kilowatts. Two of these will be for the supply of electricity for lighting and traction purposes; and the third kept in reserve. In addition to the machinery, there will be distributing mains in the compulsory area, for traction, lighting, &c. The population of Farnworth in 1891 was 23,758; and the present population is estimated at 26,000. The total rateable value of property is £76,995; the amount assessable to the district rate being £72,721. The outstanding debt of the Council under the Sanitary Acts amounts to £52,376. The area of the township is about 1502 acres. The Council own the present tram-lines; and the Bolton Corporation are supplying electricity for running the cars over them until some time in 1902. The Inspector having asked if any canvass had been made of the ratepayers, in order to see what consumers of electricity there would be, and as to the revenue therefrom, it was stated that there had been none; but an influential deputation, including millowners and other ratepayers, had waited upon the Council and urged them to provide electricity. A fairly good profit was expected to be made. There was no opposition to the project or to the present application. A term of 25 years was asked for the repayment of the principal and interest of the £22,000 required; it being pointed out that something like three years would elapse before there would be any return for the expenditure. The Inspector intimated that he would visit the site; and the inquiry then concluded.

The Tarapaca Water-Works Company, Limited, have announced a final dividend of 4½ per cent.; making 7½ per cent. for the past year.

## THE FALMOUTH CORPORATION AND THE WATER-WORKS.

Another attempt is to be made by the Falmouth Town Council to obtain the consent of the ratepayers to the proposed purchase of the water-works. At a recent meeting of the Council, the Water Supply and Water Purchase Committee recommended that a Bill be introduced in the next session of Parliament to provide, among other things, for the purchase of the water-works, "if so decided." The recommendation was adopted, with the addition of the words "by the ratepayers" after "if so decided." At the same meeting, a letter was read from Mr. J. G. Cox, the Manager of the water-works, in reference to the report in which Dr. Buchanan, a Medical Inspector of the Local Government Board, connected a recent epidemic of typhoid fever with the water supply, and particularly with the intermittence of the service. In the letter, which dealt at length with the facts of the case, Mr. Cox said the Company had conferred a boon on the town for many years, and for more than half-a-century, with the exception of last summer, the health of the place had been good and the death-rate low. The persistent and unwarrantable attempt to connect the cause of that exception with the Company's water, and so depreciate the value of the undertaking, utterly failed; being founded on misrepresentation and what was not true, and resulted only in injury to the neighbourhood and loss to the inhabitants, who disapproved of the attacks. The Company had spent money without stint to improve the quantity and quality of the supply, and it had never been proved to be impure or unwholesome. The Directors had introduced most effective sand filtration. Dr. Buchanan's theories were an entire misconception of the facts of the case. It was decided to inform the Company, in reply, that the Council did not consider that the recommendations of Dr. Buchanan had been satisfactorily dealt with. There was need for frequent and systematic inspection of the sources of supply, for greater pressure on the sanitary authority through whose district the streams pass, and for the remedying of defects in the filtration which had been already pointed out. The Council considered it most important that there should be a continuous supply of water throughout the borough, as an intermittent supply was, in the opinion of Dr. Buchanan, the cause of insuction of polluted air into the water-pipes. Another matter calling for alteration was the lack of pressure on the high-level service.

**The "Builder" on the Testing of Gas.**—Referring to the increase in the price of gas in London, the "Builder" says: "The great increase in the price of coal will probably necessitate a general rise in gas prices in many parts of the kingdom, and will doubtless result in the admixture of even larger proportions of carburetted water gas with the coal gas than are already employed. Having regard to the fact that carburetted water gas has a lower heating value and a higher specific gravity than coal gas of the same illuminating power, we may again draw attention to the desirability of introducing a heating-power test in the series of tests carried out by the official gas examiners, and to the fact that gas appliances adapted to burn coal gas are not fitted to burn the heavier gas unless it be supplied to the burners under a greater pressure."

LONDON.
WARRINGTON.
STRATFORD.
PLYMOUTH.

DUBLIN.
BOURNEMOUTH.

## NOTES FROM SCOTLAND.

**From Our Own Correspondent.**

*Saturday.*

Though Selkirk is on the western border of the Waverley district, and is not very convenient of access to many of the members, there was a gratifying attendance at the meeting of the Waverley Association of Gas Managers there on Thursday. And if the attendance was good, so were the proceedings. The subjects dealt with were within the reach of all; and the speaking was spontaneous. Information was freely given—a circumstance which drew from Mr. Bell, of Dalkeith, the remark that it used to be very different in the days before the establishment of Gas Managers' Associations. Mr. Bell is full of reminiscences of the early days of gas supply. At the dinner table, he was able to tell that Selkirk was the first of all the towns in the south of Scotland to adopt gas lighting. There was living in the town a shoemaker—by name John Young—who began to make gas for his own use. He manufactured his own gas-pipes, of tin; and he employed a tub for a gasholder tank, and a butter firkin for a gasholder. Mr. Young was afterwards Manager of the Selkirk Gas-Works, and latterly at Dalkeith, and was widely known and respected among gas managers. Another incident of interest came out at the dinner. Ex-Provost Roberts, of Selkirk, who is Chairman of the Selkirk Gas Company, mentioned that, although they had gas-works which were worth about £25,000, they had been so largely built and renewed out of revenue that the capital of the Company was only £4500. Thus the self-denial of the shareholders in the past makes it easy to get along now when competition has arisen. Of how few companies can the same be said. At the meeting, Mr. Bell spoke upon the subject of meter-unions. He takes the same view as I did last week—that it is the gas managers themselves who are responsible for the non-use of the standard meter-unions. The standards have been made and purchased by the Scotch meter makers, ready for use; but no one has given an order for unions made according to them. Is it fear of the Board of Trade which keeps managers back? Surely it need not be. The Board of Trade have never interfered while higgledy-piggledy orders have been given. If they were to interfere when an endeavour to produce uniformity is being made, they would do an ungracious—indeed, an unjust-act. A question in the House of Commons would soon elicit whether there was any likelihood of the Board of Trade putting a stumbling-block in the way of standardizing meter-unions in accordance with the arrangements come to between the gas managers and meter makers in Scotland. I am sure that Sir William Arrol would be quite willing to put any such question. The giving of burners free seems to be almost universal in the Waverley district. Any such action must be entirely *ex gratia*. No company or corporation can resolve to make the receipt of such a supply compulsory. All they can do is to proffer the burners and recommend them; offering, perhaps, at the same time to fix them. If it can be done of consent, there is no harm in giving free burners; but to go further would excite suspicion, and the means would then defeat the end. In the homely towns in the Waverley district, the giving of free burners seems to work well.

Gas managers in the Waverley district are not so enthusiastic as were their colleagues who spoke at Glasgow, in favour of a reduction in the illuminating power of the gas they supply. They are not being pressed much by electric light. There is not a public installation in any of the towns in the district; and none is as yet proposed. They have been accustomed to use the best coal; and they have seen it dearer than it is now. If it came down from high prices before, it may do so again; and in the meantime, the gas undertakings will in a sense "muddle through." This seems to be the position of the managers in the Waverley district; their expectations being probably considerably heightened by the knowledge of the cost it would be to them to alter their works to suit a supply of lower-grade gas. Most likely they are right, so far as they themselves are concerned. It may not cost so much, relatively, in larger towns to reduce the illuminating power; and if a few of them were to go in for the reduction, then the remaining cannel would be available for smaller places, such as the Waverley towns. The gas undertakings in them would thus have a new lease of life.

Mr. Hubert Pooley, of Dunfermline, has presented to his Committee an exhaustive report upon the subject of the extension of the carbonizing plant in the gas-works. He describes the three methods by which increased output may be obtained—by horizontal retorts, by sloping retorts, and by carburetted water gas. The extent to which he suggests that the retort-bench should be added to is four arches, holding eight settings of retorts. With horizontal retorts, the cost he estimates at £2500; and the working expenses per week, at £255, less £84 for residuals—leaving the working expenses at £171, which is equal to an average for the year of 12·23d. per 1000 cubic feet. Sloping retorts of 20 feet in length, he estimates to cost £130 each, inclusive of everything connected with the plant; but as it is necessary to have a height of wall to the eaves of 51 feet, and at Dunfermline the present height is only 39 feet, an extra outlay of £580 would be entailed in raising the walls and roof. The total cost would be £4740; and the working expenses for a week would be £237, less £84 for residuals; leaving the net working expenses at £153. The average working cost would be 12·23d. per 1000 cubic feet. Carburetted water-gas plant capable of producing 200,000 cubic feet of gas per day would cost £2300; but a relief holder, oil storage, and other accessories would be required, which would raise the total cost to £4700. The working cost, to enrich coal gas to 22·59-candle power, would be 20·89d. per 1000 cubic feet. He therefore considers that, with oil at its present value, it is quite out of the question to adopt carburetted water gas as a means of increasing the producing capacity of the works. The estimated saving by the adoption of inclined retorts would be 0·72d. per 1000 cubic feet, which, on a total manufacture of 83 million cubic feet a year, would amount to £249; but interest and sinking fund, at the rate of 6 per cent., would equal £143—leaving a net saving of £106. The conclusion Mr. Pooley comes to is that, considering the present state of the capital account, and that the whole appearance of the works would be changed for the worse by the alterations to the structure of the retort-house, a saving of £106 per annum would not justify the heavy extra cost of sloping retorts, more especially as there had been no allowance made for depreciation; and he does not hesitate to strongly recommend the


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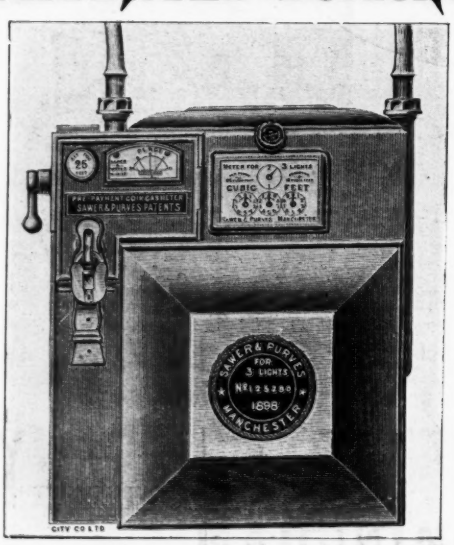


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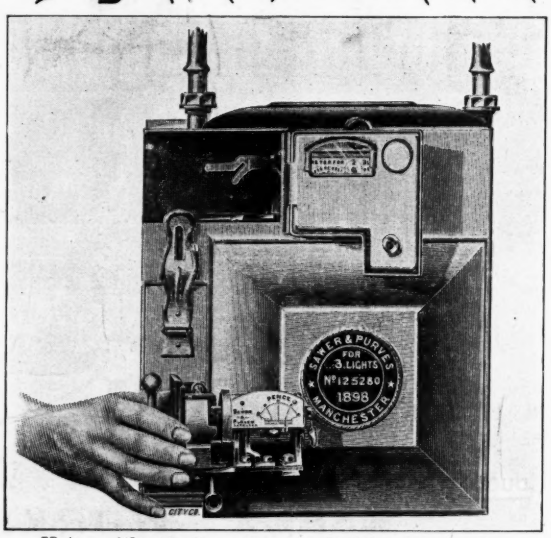


Meter with attachment removed without uncoupling.

Commissioners to proceed with the erection of horizontal retorts with as little delay as possible. The report comes up for consideration at the next meeting of the Commissioners. The matter is made so plain to them, that they should have no difficulty in determining what to do.

What is being treated by the newspapers as a "scene" occurred at a meeting of the Perth Gas Commission this week. Bailie Taylor gave notice of a motion in the following terms: "That, owing to some of the gas schemes for which the Commissioners are applying for a Provisional Order to meet the cost not having been considered by the Gas-Works Committee, the Commissioners rescind the resolution passed on the 8th inst, and delay applying for additional borrowing powers, and remit the whole question back to the Gas-Works Committee." Lord Provost Macgregor said that he had considered the question, and, in the public interest, he was bound to hold that the motion was incompetent. They had, after hearing the Convener's statement, unanimously resolved to go on with the application for a Provisional Order; and they could not now go back upon that. Under their resolution, they had incurred liabilities, and were in process of proceeding with the works, on the strength of getting the money. The "scene" then arose—Bailie Taylor and Mr. Anderson both taking part in it, in the hope of getting the Lord Provost to re-consider his ruling. In this, they were unsuccessful; and the incident ended without result. In the circumstances, the Lord Provost could give no other ruling; but it is somewhat curious that the Commissioners should have resolved to go on with a large scheme without (as a body) considering it. The situation bears out what I said a fortnight ago —that Mr. Wilson was not asked to report upon the new works. The Convener of the Works Committee seems to have had notions of his own regarding what should be provided; and a report from the Manager, or a discussion in the Commission, might disturb his plans. It is easy to perceive how difficult it must have been to deal with such people. So marked a departure from the method followed by all other bodies was, almost to a certainty, bound to end in failure somewhere.

A flagrant instance of unlovely parochialism has been manifested by the Town Council of Stirling in their dealing with the Stirling Gaslight Company. In fixing the valuation, they (to use the common phrase) put it on. To them it mattered nothing that the law has laid down that gas undertakings are to be valued according to a fixed principle. The Gas Company, however, were happily able to find relief, in the services of the Public Assessor of Canals and Railways. Even he did not quite please the Company, who thereupon made representations to the Assessor. As a result, the Assessor struck off about £200 from his valuation—leaving it at £2939. Then came the turn of the Town Council to be displeased; and they appointed a deputation to wait upon the Assessor regarding the subject. So far from success attending the efforts of the deputation, the Assessor was able to convince them of the justice of his valuation. This week the deputation reported to the Town Council, recommending that no appeal be lodged against the decision of the Assessor; and the Council agreed to this course. If this should prove to be the last of the "dog in the manger" policy of the Town Council, there should be a feeling of relief all round.

I wrote last autumn about the proposed erection of a new gasholder at Banff, upon ground recovered from the sea. At that time, it was expected that the work could be gone on with promptly—weather permitting; but the ways of municipalities are not of the electric order, and it is only now that the Gas Company have been able to secure the space upon which to erect their gasholder. The Corporation were obliged to go through the form of an auction of the site. It is only a bit of rock, which will require a good deal of labour to chip away before it can be available for any purpose; and there were not likely to be any competitors for it. It could not, however, be given even at a fair rate, without competition being afforded; and the Gas Company have consequently had to wait upon the "dread" forms of law.

## CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *April* 12.

**Sulphate of Ammonia.**—The tone of the market is again weaker; and a further decline in values has to be recorded. There continues to be good inquiry; but buyers' ideas of price are constantly receding, and the bulk of new business has been limited. Supplies are not excessive; but makers have displayed greater anxiety to sell, and have more freely accepted reduced prices. The closing quotations are £11 10s. to £11 12s. 6d. per ton f.o.b. at the ports. There is very little interest in the forward position; and no important business is reported.

**Nitrate of Soda** is easier on spot, owing to arrivals; the quotations being 8s. 7½d. to 8s. 9d. per cwt., according to quality. The general position is, however, unchanged.

LONDON, *April* 12.

**Tar Products.**—The "slump" in benzols goes from bad to worse, A very large business in 90's is reported at 4¼d., less 2½ per cent.. naked at makers' works. Remembering that a few years ago benzol was sold at 15s. per gallon, this remarkable fall in price, especially having regard to the diversified uses to which benzol may be applied, is phenomenal. There can be no doubt, however, that at these low prices new uses for benzol will be found, and the continually increasing production absorbed. If it were not that large quantities of specially prepared benzol are now being utilized for gas enrichment, manufacturers would be in a helpless position. There is a little more inquiry for creosote and heavy oils. The production of these is now falling off rapidly; and the consumption of them is simultaneously increasing with the better weather – particularly in the direction of pickling timber. Carbolic acid is decidedly in better tone; and it is not unlikely that, should the present demand continue, prices may be advanced. Solvent naphtha is at last seriously prejudiced by the low prices of benzol. It is to-day quoted at a lower figure than it has been offered at for many years; and even at that price, it is difficult to find buyers. Anthracene is again more interesting, and the business in it is resuming more normal features. The future of this product is more hopeful, especially as it is now seen that the production is rapidly falling off.

Average quotations during the week are: Tar, 17s. 6d. to 27s. 6d.


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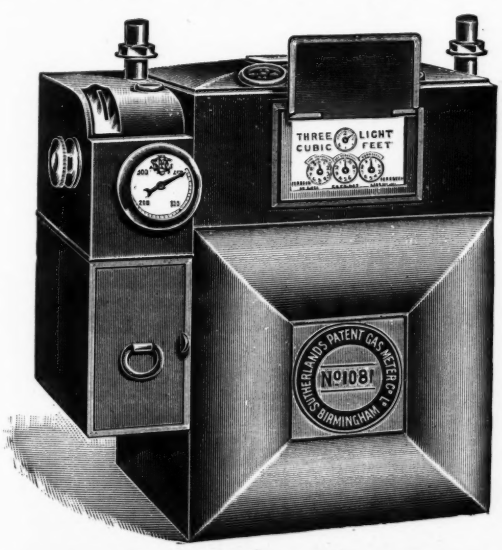


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**Sulphate of Ammonia.**—This market is again reported weaker; and curiously this is in face of lessened production, absence of stocks in makers' hands, and increased shipments. Considerable variation exists in respect to the ports of shipment; Liverpool latterly being the best market, owing doubtless to its better facilities for shipment. The average of all the ports will show an amount of £11 15s. per ton, less 3½ per cent.

## COAL TRADE REPORTS.

### From Our Own Correspondents.

**Lancashire Coal Trade.**—During the past week, there has been perhaps rather more inquiry for all descriptions of fuel, owing to merchants and consumers getting in supplies prior to the holiday stoppages, which in some cases have extended over three or four days. There is a generally strong tone all through the market, with a continued shortness of supplies. The better qualities of round coal have so far met with a ready sale for house-fire purposes, which has prevented collieries putting down anything into stock. This strengthens the probability of present maximum prices being maintained during the ensuing summer. Inland requirements for steam and forge purposes show no falling off; and the output of common round coals is barely keeping up with deliveries to meet requirements of customers, with the result that prices are not only firm but tend to harden on recent rates. The advance on engine classes of fuel in the Manchester district, reported last week, is being obtained without difficulty, but so far has not been followed outside the immediate neighbourhood—including Bolton, Oldham, Tyldesley, and Leigh—the West Lancashire collieries for the present holding back from any further upward move, as they consider that their prices were previously much above the level of those ruling in the Manchester district. At the pit, general quotations may be given as firm at about 14s. 6d. to 15s. 6d. per ton for best Wigan Arley, 13s. to 14s. for Pemberton four-feet and seconds Arley, 12s. 6d. to 13s. for common round coals, 10s. to 10s. 6d. for medium sorts of slack, up to 11s. and 11s. 3d. for the very best qualities. In the shipping trade, the slackening off recently reported is still noticeable; buyers in many cases holding back from paying present rates. But the Lancashire collieries hold firmly to their minimum basis of 16s. per ton for steam coal, delivered at the ports on the Mersey. Coke makers are getting the advanced rates readily, and are still behindhand with deliveries; but it is hoped that the holiday stoppages of works may possibly place them in a better position in this respect. Ordinary furnace cokes are fetching from 24s. to 25s. per ton, and foundry descriptions, according to quality, from 29s. up to 32s. at the ovens.

**Northern Coal Trade.**—The demand for coal has been stronger the last few days, in preparation for the holidays; and prices have been firmer. Shipments have been very heavy—especially to the near Continental ports; and, with a full home demand, there is the taking up of the large output. For best Northumbrian steam coals, the quotation is now about 18s. per ton f.o.b.; while steam smalls, which are scarce, are from 11s. to 12s. per ton. In gas coals, it is believed that parts of the large contracts for London have been given out; and though no details are yet officially procurable, it is thought that the price is equal to from 15s. 9d. to 16s. per ton f.o.b. For occasional cargoes, the quotation is 16s. to 17s. per ton. In the coke trade, demand is active; and prices are very firm—exports being heavier. For gas coke, there is a brisk demand; and as there is now a general reduction in the output, the stocks have been reduced, and the prices may be said to be firm on the basis of about 16s. per ton f.o.b.

**Scotch Coal Trade.**—The demand for all classes continues good; and prices are easily maintained—an advance of about 6d. per ton being obtainable for forward contracting. The Baltic trade has begun, which will increase the demand. The prices quoted are: Main, 14s. to 14s. 3d. per ton f.o.b. Glasgow; ell, 15s. to 16s.; and splint, 15s. to 16s. The shipments for the week amounted to 195,850 tons—a decrease of 10,646 tons upon the preceding week, but an increase of 34,496 tons upon the corresponding week. For the year to date, the total shipments have been 2,586,871 tons—an increase upon the same period of last year of 633,556 tons.

**Singapore Gas Company, Limited.**—The Directors' report for the year ended Dec. 31, to be presented to the shareholders at the ordinary annual general meeting on the 26th inst., states that the accounts show a similar result to those of the previous year. The profit was £3512, which, added to £357 brought forward from the previous year, makes a total of £3869 After deducting £1524 paid as interim dividend and debenture interest a balance is left of £2345, out of which the Directors recommend the payment of a dividend, for the last six months, of 4 per cent. per annum—making 3½ per cent. for the year, and leaving a balance of £1059 to carry forward.

**Italian Gas Company.**—At the recent general meeting of this Company, the Directors reported that the additional capital sanctioned at the last meeting made it possible to purchase the Palermo and Girgenti Gas-Works and all the shares of the Milan Gas Industry, likewise those of the Ferrara Company. As was anticipated last year, the considerable extension of the Company's property has greatly increased their former power, and enabled them to resist all adverse influences, the most serious of which is the price of coal. As regards the operation of the individual works, those at Bergamo, Pavia, Tortona, and Palermo all showed a considerable increase in the consumption of gas; and the Company intended to continually make improvements in these works. At Milan and Ferrara things were also satisfactory. The balance-sheet for the past year was submitted. The total receipts amounted to 26,399,002 lire, and the profit allowed of the payment of a dividend of 30 lire per share, 15 lire of which had been paid.


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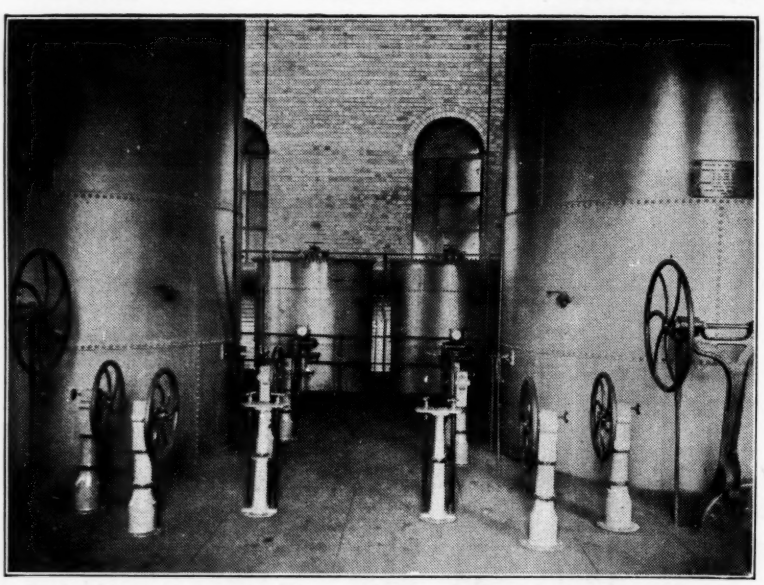

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**Water Supply at Less than Cost Price for Bradford.**—At the meeting of the Bradford City Council last Tuesday, Mr. E. R. Hartley inquired as to the truth of a published statement that for a period three firms had been receiving water at a daily loss to the Corporation of £375. Alderman Holdsworth, in reply, admitted that there were more than 143 consumers who obtained water at less than cost price. It would, however, be unwise to burden these people so that they could not compete with firms in other towns; but the Water Committee were going thoroughly into the whole question of prices. As to the loss of £375 a day referred to by Mr. Hartley, that was hardly a fact; but he did admit, if everybody paid 9d. per 1000 gallons, there would be a big profit.

**Plymstock Water Supply.**—Considerable rejoicing took place at Plymstock last Saturday week on the occasion of the inauguration of a supply of water for the village. The subject had been under consideration for several years, when the Rural District Council consulted Mr. H. Francis, the Engineer of the Devonport Water-Works, and on his advice decided to further draw upon the springs which supply Plympton, and to construct a reservoir for the separate service of the village. About 11 miles of mains have been laid. A covered reservoir has been constructed 59 feet long, 40 feet wide, and 12 feet deep, with a water depth of 10 ft. 3 in.; giving a capacity of upwards of 100,000 gallons. The original estimate of the cost was £7500; but the mains were extended beyond the original intention, at a further cost of £800. Applications have been received for more than 300 supplies; and already two-thirds of the interest and sinking fund are provided for. Mr. J. J. M'Andrew, the Chairman of the Plympton Rural District Council, publicly turned on the water, and expressed the opinion that the fact that the district was assured of an abundant supply would have a great influence upon its future prosperity.

**Hydro-Incandescent Gas-Light Company, Limited.**—At the first general meeting of this Company, held at the Westminster Palace Hotel last Tuesday, under the presidency of Mr. G. T. Augspurg, the accounts presented, covering a period of nineteen months (May 24, 1898, to Dec. 31, 1899), showed a debit balance of £7724, including £862 for Directors' fees, which it had been decided to waive. The Chairman, reviewing the history of the undertaking, stated that the prospectus was issued with the approval and sanction of the Welsbach Company, and the Company was not formed to exploit and work the patents they acquired, but only to exercise control over the proper working of a licence given to the Incandescent Gas-Light Company, Limited. The Company had given up the option granted to them by the International Hydro Company of Hamburg to the Welsbach Company against a cash payment of £5000 and the undertaking, for a minimum period of five years, to manufacture and sell the hydro apparatus—paying over 50 per cent. of the gross profits. It was solely owing to the reliance placed by the Directors on the proper carrying out of this agreement that they deemed it advisable to go to allotment on the small amount subscribed by the shareholders. In the opinion of the Board, the Welsbach Company had not complied with the terms of the agreement; and on this account the Directors were claiming £5000 damages for breach of contract. The Company were now in a position to acquire on very moderate terms what they considered to be the best compressor among all its rivals, not only as regarded compactness, but also as far as cost and efficiency were concerned. The Directors had deemed it advisable to secure options of some valuable inventions, which would, in their opinion, constitute an additional source of revenue. In order, however, to take up and efficiently work these patents, further capital was required; and the Board had been taking steps to reconstruct the Company or to form an entirely new one to purchase all or a portion of the inventions. For the purpose of further considering these proposals, he requested the meeting to appoint a small Committee to confer with the Board and the representatives of the Hamburg Company. A discussion ensued, at the close of which a Committee was appointed to investigate the affairs of the Company, and to confer with the Directors regarding the future.

**Gas Explosion at a Devonport Barracks.**—An explosion of gas occurred at the South Raglan Barracks, Devonport, last Tuesday evening, causing serious injury to one soldier, and also hurting two others. A private named Purnell went to light a gas-jet at the top of a flight of stairs, when flame burst out at the base of the bracket, and was followed almost immediately by an explosion which threw him down the stairs, blew down a partition dividing the landing from a room occupied by non-commissioned officers, and did considerable damage to the building. There was no suspicion of an escape before the explosion took place; but there seems to have been a considerable accumulation of gas in the room adjoining the landing. Purnell, who sustained a fracture of the skull and other injuries, was taken to the hospital, and the two other soldiers were placed under treatment.

**The Remodelling of the Teignmouth Gas-Works.**—At a special meeting of the Teignmouth District Council last Tuesday, plans for extending and remodelling the gas-works were considered. Mr. C. Jones explained that a scheme prepared by the late Manager (Mr. J. Portbury) would entail an outlay of £1592; but the plans had since been revised, and in their new form it would mean an expenditure of about £2123. The carrying out of this scheme would produce entirely new gas-works. The plans had been passed and approved by the Local Government Board, and £1500 advanced, £500 of which had been spent in the construction of the new gasholder. The second set of plans submitted were from the present Manager, Mr. Stormonth, who disagreed entirely with those which had been approved. His idea was that the works were conducted on the most costly system known; that the gas was produced on a scale calling for a high price to the consumer (4s. 2d. per 1000 cubic feet), and that the residuals did not produce as much as they should do. By remodelling the works according to his plans, they would carbonize more than double the quantity of coal with less labour and cost, and gas would soon be sold cheaper, and the cost of the works would be about £1300. It was resolved to accept Mr. Stormonth's plans, subject to the approval of the Local Government Board.

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The Seulcoates Rural District Council have resolved to apply for the permission of the Local Government Board to the borrowing of £5081 for the purpose of constructing water-works.

The costs incurred by the Yeadon, Guiseley, and Rawdon District Councils in opposing the Gas Company's Bill amount, after taxation, to £1050; Yeadon's proportion—£544—being equal to a rate of nearly 8d. in the pound.

The Campbell Gas-Engine Company, of Halifax, are supplying, to the order of the War Department, portable oil-engines, with dynamo and search-light apparatus, which the engines are intended to work, for use in the campaign in South Africa.

With reference to the article on the supply of gas and electricity in Manchester, which appeared on p. 956 of the last issue of the "JOURNAL," we are asked by Messrs. Alexander Wright and Co., Limited, to state that the order for the standard gasholders to be supplied to the Rochdale Road and Gaythorn works was placed with them, as was also that for the maintenance of the photometers, for the ensuing year.

Our readers are aware that the whole of the buildings on the estate of the Prince of Wales at Sandringham, including Sandringham House and York Cottage (the residence of the Duke of York), have been lighted with the latest pattern lamps of the Welsbach Incandescent Gas Light Company, Limited—principally the new burners of small sizes. Gas had not previously been used in the private apartments of His Royal Highness—the building having been electrically lighted. But the incandescent gas system has been carried out in conjunction with the use in many of the rooms of the "Surprise" pendants of Messrs Best and Lloyd, with the result that very effective lighting combined with facility of changing the position of the light-centre has been secured.

**NOTICE TO ADVERTISERS.**—COPY FOR ADVERTISEMENTS for the "JOURNAL" should be received at the Office *not later* than TWELVE O'CLOCK NOON ON MONDAY, to ensure insertion in the following day's issue.

Orders for Alterations in, or Stoppages of, PERMANENT ADVERTISEMENTS should be received not later than the FIRST POST on SATURDAY.

GAS PURIFICATION AND CHEMICAL COMPANY, LIMITED.

OXIDE OF IRON.

O'NEILL'S Oxide has a larger annual sale than all other Oxides combined. Purity and uniformity of quality guaranteed.

JOHN WM. O'NEILL, Managing Director,
160, 161, & 162, PALMERSTON BUILDINGS,
OLD BROAD STREET,
LONDON, E.C.

ANDREW STEPHENSON, AGENT. All communications *re* Oxide to the Company as above.

WINKELMANN'S

"VOLCANIC" FIRE CEMENT.

Resists 4500° Fahr. Best for use in GAS-WORKS.

ANDREW STEPHENSON,
182, Palmerston Buildings,
Old Broad Street,
"Volcanism, London." London, E.C.

BROTHERTON & CO.

Offices: Commercial Buildings, LEEDS. Correspondence invited.

HYDRATED OXIDE OF IRON.

PREPARED from Pure Iron.

Twice as Rich as Bog Ore.
Gives no Back Pressure.
The Cheapest in the Market.
Can be Lent on Hire.
Can be Exchanged for Spent Oxide.

READ HOLLIDAY AND SONS, LTD., HUDDERSFIELD.

J. & J. BRADDOCK (Branch of Meters Limited), Globe Meter Works, OLDHAM; and 45 & 47, Westminster Bridge Road, LONDON, S.E.

First-Class Award, Melbourne Exhibition, 1889, for WET AND DRY GAS-METERS, STATION METERS, AND GOVERNORS, PRESSURE-GAUGES, STREET LAMPS AND PILLARS, &c.

Telegraphic Addresses:
"Braddock, Oldham." "Metrique, London."

SULPHURIC ACID.

JOHN NICHOLSON & SONS, Limited, Chemical Works, Leeds, specially produce this ACID from SULPHUR, for making SULPHATE OF AMMONIA of high quality and *good* colour. Delivery in our own Railway Tank-Wagons or Carboys. Highest references and all particulars supplied on application.

AMMONIACAL LIQUOR wanted.

BROTHERTON AND CO., Ammonia Distillers. Works: BIRMINGHAM, LEEDS, and WAKEFIELD.

BENZOL, specially made for the Enrichment of Gas.

ELLISON AND MITCHELL, LIMITED, Kilnhurst, near ROTHERHAM.

NEW GAS PLANT CEMENT.

JOHN E. WILLIAMS AND CO.,
VICTORIA PAINT WORKS,
MANCHESTER.

For all Joints in connection with Oil-Gas Plant and Sulphate Plant.
For all Gas Joints.
For all Tar Joints.
For all Ammonia Joints.

GAS PURIFICATION.

OXIDE OF IRON BOG ORE.

BALE & CO.'S Oxide of uniform quality.

SPECIAL FIRE CEMENT, OXIDE PAINTS, OILS, SULPHURIC ACID, &c.

120 and 121, NEWGATE STREET, LONDON, E.C.
Telegrams: "BOGORE, LONDON."

SADLER & CO., Ltd., Middlesbrough,

Tar Distillers and Tar Colour Manufacturers. BENZOL specially prepared for Gas Enrichment free from Sulphur. Pure Hydrated OXIDE OF IRON for Purifying Gas either for Sale or Lent on Hire. Always Buyers of GAS TAR and AMMONIACAL LIQUOR.

TO GAS AND WATER OFFICIALS.

HIGH-CLASS Cycles at reasonable and low Prices. Guaranteed for Twelve Months. Sent on approval. For Cash or Gradual Payment System. Send for Catalogue, Post Free.

MELROSE CYCLE COMPANY, COVENTRY.

SULPHURIC ACID for Sale.

BROTHERTON AND CO., Chemical Manufacturers. Works: BIRMINGHAM, LEEDS, and WAKEFIELD.

CANNEL, COAL, ETC.

JOHN ROMANS & SON, EDINBURGH,

Gas Engineers, supply all the most approved SCOTTISH CANNELS; also FIRE-CLAY GOODS, CAST-IRON PIPES, and other APPARATUS for GAS and WATER WORKS.

Prices, &c., will be forwarded on application
No. 80, ST. ANDREW SQUARE, EDINBURGH, } SCOTLAND.
NEWTON GRANGE, NEWBATTLE, DALKEITH, }

**GAS TAR wanted.**
BROTHERTON AND Co., Tar Distillers. Works: BIRMINGHAM, LEEDS, and WAKEFIELD.

**PATENTS FOR INVENTIONS.**
Messrs. J. C. CHAPMAN & CO., Chartered Patent Agents, ADVISE ON ALL MATTERS CONNECTED WITH ABOVE.
Information and Handbook on application.
70, CHANCERY LANE, LONDON, W.C.

**ENRICH your Gas with cheap Benzol.**
Specially prepared, free from sulphur. At to-day's Price of Benzol, ILLUMINATING POWER costs less than ONE-THIRD OF A PENNY PER CANDLE.
Apply to SADLER AND Co., MIDDLESBROUGH.

PRACTICAL RETORT SETTERS.
**GEORGE NUTTALL & CO., 32, Havelock Road, Saltley, Birmingham.**
Regenerator or other Furnaces erected to Engineers' own Designs. Best Work Guaranteed. Please write for Estimates.

SULPHATE OF AMMONIA SATURATORS.
**JOSEPH TAYLOR & CO., Chemical Plumbers, &c., and Makers of every description of Solid Plate Lead and Timber Cased Saturators, &c.,** CENTRAL PLUMBING WORKS, TOWN HALL SQUARE, BOLTON. Special attention to Repairs.
Before placing Orders, please write for Estimate.
Telegraphic Address: "SATURATORS, BOLTON."

**PORTER & CO., Gowts Bridge Works,** LINCOLN, Engineers, Ironfounders, and Contractors for the erection of Gas-Works for Towns, Villages, Mansions, Manufactories, Collieries, and Isolated Buildings at home and abroad. Manufacturers of Retorts and Fittings, Condensers, Scrubbers, Purifiers, Valves, &c.; also of Girders, Wrought and Cast Iron Tanks, Iron Roofs, &c.
Telegraphic Address: "PORTER, LINCOLN."
[For Illustrated Advertisement, See April 3, p. 898.

**WANTED, good Retort Setters immediately.**
Apply to JONAS DRAKE & SON, Gas Engineers, Ovenden, HALIFAX.

DRAUGHTSMAN.
**WANTED, by the Cheltenham Gas** Company, an experienced DRAUGHTSMAN.
Apply, stating Age, and Salary expected, to Mr. R. O. PATERSON, Engineer and Manager.

**WORKING Manager for Small Gas-** Works wanted. To do the whole of the work himself, superintend Repairs, &c. Weekly Wages about 22s. 6d. in summer; about 28s. in winter. House, Gas, and Coal free.
Apply, with Testimonials, to GEORGE TOVEY, Winchcombe, R.S.O., GLOS.

**WANTED, a steady, sober, and reliable** Married Man as DAY STOKER, and willing to make himself generally useful. Working seven Retorts in Winter and three in Summer. To a suitable Man 25s. per week, with Cottage and Garden.
Apply, by letter, stating Age and Family, to No. 3475, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

**REQUIRED, a Junior Clerk in a small** Gas and Water Works Department. Fully competent to check Meter Reading, make out Rental Lists, and enter up Minutes of Board Meetings under supervision of Secretary. Quick and good Writing indispensable.
Apply, stating past Experience and Salary required, to Box 50, "Courier" Office, TUNBRIDGE WELLS.

**WANTED, a Working Foreman for** Water and Gas Companies. Water Supply by Gravitation. Make of Gas about 12 millions per annum. One accustomed to Generator Furnaces preferred. Must have a thorough knowledge of Main and Service Laying and Fitting. Salary £2 per week, with House, Coal, Gas, and Water free.
Apply, stating Age, number in family, and with *copies* of recent Testimonials, to GEO. E. WOODFORD, RUABON

DERBY GASLIGHT AND COKE COMPANY.
**WANTED by the Directors of this Company** an experienced and competent ENGINEER AND MANAGER to take entire charge of their Works (make about 550 million cubic feet). He must have a practical knowledge of the Manufacture of Coal and Water Gas and Sulphate of Ammonia upon the best modern systems. The person appointed to devote the whole of his time to the duties, and be able to design and carry out Alterations and Extensions of Plant.
Applications to be by letter, marked "Engineer," stating Age, Salary required, Training and Experience, accompanied by *copies* of three Testimonials of recent date, addressed to the CHAIRMAN, at the Company's Office, Friar Gate, DERBY, on or before May 8, 1900.

**SHARES wanted in C. & W. Walker,** Limited, either Preference or Ordinary.
State Number for disposal and Price required to No. 3468, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

**GAS PLANT for Sale—I can always offer** NEW and SECOND-HAND GAS APPARATUS, including Retorts and Fittings, Condensers, Exhausters, Scrubbers, Washers, Purifiers, Gasholders, Tanks, Valves, Connections, &c. Also a few COMPLETE WORKS. Compare Prices and Particulars before ordering elsewhere.
J. F. BLAKELEY, Gas Engineer, Thornhill, DEWSBURY.

**SPENT OXIDE on Sale, and Fresh Oxide** required, at the Dukinfield Gas-Works.
Apply to the MANAGER.

**CONDENSER (Morris & Cutler's), 21 ft.** 6 in. by 6 ft. 6 in. by 8 ft. 6 in., 1 million per day. Equal to new. Exceptional Bargain, if sold promptly.
Address No. 3463, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

**FOR SALE—Two Lancashire Boilers,** each 6 ft. diameter by 20 ft. long, with Mountings. Been in use only a short time. Made by the Yorkshire Engine Company, Limited, Sheffield.
Apply to NEWTON, CHAMBERS, & Co., LIMITED, Thorncliffe Iron-Works, near SHEFFIELD, where the Boilers may be seen.

**EXHAUSTERS, 1500 to 60,000 feet per** hour, with or without Engines.
LIVESEY WASHERS, CUTLER CONDENSER, SCRUBBERS, 5 feet and 6 feet diameter, METERS, GOVERNORS, PURIFIERS (Sets of 6 feet and 10 feet square), BOILER and other TANKS, VALVES, &c.,
J. FIRTH BLAKELEY & Co., Thornhill, DEWSBURY.

GAS PLANT FOR SALE.
**THE Coatbridge Gas Company will have** FOR SALE shortly, the following second-hand Plant, which is in as good condition as new—viz.,
(1) One square STATION METER, with 12-inch Valves and Connections. Capacity 25,000 Cubic Feet per hour.
(2) A double set of ENGINES and EXHAUSTERS (Dempster's Horizontal), with Valves and Connections. Capacity 25,000 Cubic Feet per hour.
(3) One 15-inch WATER-LOADING COWAN GOVERNOR, with Bye-pass Valves and Connections.
(4) Two CORNISH STEAM-BOILERS, 18 ft. by 6 ft., with Galloway Tubes and Mountings.
Offers for these to the undersigned
THOMAS WILSON,
Manager and Secretary.
Gas-Works, Coatbridge, April 12, 1900.

SHANKLIN GAS COMPANY, LIMITED.
GAS PLANT FOR SALE.
**OWING to the adoption of Regenerator** Settings, the Shanklin Gas Company, Limited, have now FOR DISPOSAL the following, in first-class condition:—
Three Sections of HYDRAULIC MAINS, two for Beds of six Retorts, and one for Bed of five Retorts; 17 OVAL MOUTHPIECES, 21 in. by 16 in., with all Cross-Bars, Lugs, &c., complete; all the necessary ASCENSION-PIPES, BENDS, and BRIDGE-PIPES, 6-inch SEAL-VALVES, 8-inch CAST-IRON FOUL MAIN and TAR-MAIN, with TEES, &c., to suit.
Also seven new 21 inch by 16 in. by 9 ft. 6 in. OVAL RETORTS.
The whole may now be seen disconnected upon application to the undersigned, who will furnish any further Particulars.
FRANK C. TAYLOR,
Engineer and Secretary.
Office of the Company,
Languard Road, Shanklin, I.W

COUNTY BOROUGH OF OLDHAM.
**THE Oldham Corporation Gas-Works** Committee are prepared to receive TENDERS for the supply of about 146,000 Tons of COAL and CANNEL required by them during the Year ending the 31st of May, 1901.
Specifications and Forms of Tender can be obtained on application to Mr. Arthur Andrew, Gas and Water Offices, Oldham, to whom Tenders are to be sent on or before Tuesday, the 8th of May.
A. NICHOLSON,
Town Clerk.
Oldham,
April 12, 1900.

WALLASEY URBAN DISTRICT COUNCIL.
CONTRACTS FOR STORES.
**THE Wallasey Urban District Council** are prepared to receive TENDERS to supply, for a period of One Year, from the 30th of June next, the following amongst other ARTICLES, being the principal stores required for the Gas, Water, and Electrical Department:—

| | |
|---|---|
| Stopcocks and Main Taps. | Common Bricks (Machine and Hand Made. |
| Fire-Bricks and Retorts. | Ferrules. |
| Iron and Steel. | Fire Spades and Shovels. |
| Lead & Wrought-Iron Pipes. | Oils, &c. |
| Cotton Waste. | Cast-Iron Main Pipes. |
| Copper Lamps. | Gas, Water, and Electricity Meters. |
| Lamp Columns (Gas and Electric). | Hydrants and Valves. |
| Switches and Cut-outs. | Cables and Boxes. |
| | Ring Burners & Tubing. |

Further Particulars, with Forms of Tender, may be obtained, and Samples inspected, on application at the Engineer's Office, at the Works, Great Float, near Birkenhead.
Sealed Tenders, which must be on the printed Forms, endorsed "Gas, &c., Committee, Tender for Principal Stores," and addressed to the undersigned, to be delivered by post not later than Monday, the 23rd inst.
The successful Contractors will be required to enter into Contracts and Bonds, with approved sureties, for the due completion of their Contracts.
The Council do not bind themselves to accept the lowest or any Tender, and reserve to themselves the power to divide any Tender.
By order,
H. W. COOK,
Clerk to the Council.
Public Offices, Egremont, Cheshire,
April 10, 1900.

TYNEMOUTH GAS COMPANY, NORTH SHIELDS.
TO BUILDERS AND CONTRACTORS.
TENDERS FOR RETORT-HOUSE AND CHIMNEYS.
**THE Directors of Tynemouth Gas Com-** pany invite TENDERS for the Building of a RETORT-HOUSE, 294 ft. long by 74 ft. 9 in. wide inside, and two CHIMNEY SHAFTS, each 100 feet high, to be erected at the Gas-Works, North Shields.
Arrangement and full Detail Drawings, Specification, and Quantities may be seen at the Engineer's Office, on and after Wednesday, the 18th inst., upon payment of £5 5s., which will be returned upon receipt of a *bonâ-fide* Tender.
Tenders, addressed to the undersigned, to be delivered not later than Tuesday, May 1, 1900.
(Signed) W. HARDIE,
Engineer and Manager.
Gas-Works, North Shields,
April 12, 1900.

BOROUGH OF WARRINGTON.
(GAS DEPARTMENT.)
**THE Gas Committee of the above** Borough are prepared to receive TENDERS for the following—viz.,
(1) Supplying and Erecting Six SETTINGS OF RETORTS.
(2) RETORTS, FIRE-BRICKS, and CLAY.
(3) 1000 to 8000 Tons of CANNEL.
(4) 50,000 Gallons (or part) of BENZOL for Gas Enrichment.
Further Particulars can be obtained on application to Mr. W. S. Haddock, Engineer to the Works.
Sealed Tenders, endorsed "Tender for Retorts," &c., as the case may be, addressed to the Chairman, Gas-Works, Warrington, must be sent in not later than the 27th inst.
FREDK. TAYLOR,
Secretary.
Gas Offices, Warrington,
April 10, 1900.

GLOUCESTER GASLIGHT COMPANY.
GASHOLDER TANK,
**THE Directors of the above Company** invite TENDERS for the construction of a BRICK GASHOLDER TANK (about 156 feet in diameter and about 41 feet deep) at their Works, Hempsted.
Plans may be seen, and Specifications obtained, on application to the Company's Engineer, Mr. W. S. Morland, Gas-Works, Hempsted, near Gloucester, and on payment of £1 1s, which will be returned on the receipt of a *bonâ-fide* Tender.
Sealed Tenders, endorsed "Tender for Gasholder Tank," to be sent to the undersigned at the Gas Offices, Eastgate Street, Gloucester, not later than Tuesday, the 1st day of May, 1900.
The Directors do not bind themselves to accept the lowest or any Tender.
WILLIAM E. VINSON,
Secretary.
Gas Offices, Gloucester,
April 5, 1900.

CITY OF LEEDS.
(GAS DEPARTMENT.)
**TENDERS required as below—**
For CAST-IRON PIPES, BENDS, TEES, SYPHON WELLS, and other IRREGULAR PIPES.
For RETORT MOUTHPIECES, STAND-PIPES, DOOR-FRAMES, SPECIAL BENDS, TEES, FLANGE PIPES, SADDLES, BELTS, PLUGS and CAPS, SYPHON-COVERS, &c.
Samples may be seen on application at the Stores Department, 21, Dewsbury Road, and Forms of Tender and Specification may be had on application to the undersigned.
Endorsed Tenders, addressed to the Chairman of the Gas Committee, Municipal Buildings, Leeds, will be received not later than Tuesday, the 24th inst.
The Committee do not bind themselves to accept the lowest or any Tender.
R. H. TOWNSLEY,
General Manager.
Municipal Offices, Leeds,
April 14, 1900.

UXBRIDGE AND HILLINGDON GAS CONSUMERS' COMPANY.
GAS COAL
**THE Directors of the above Company** invite TENDERS for the supply of 5500 Tons of GAS COAL, deliveries of which are to commence the first week of May, 1900, and finish the last week in April, 1901.
Tenders to be made out for 5500 Tons of the best description of unscreened Gas Coal from the Durham Coal-Fields, delivered by Barge (free) alongside the Company's Works, Grand Junction Canal, or for the same quantity from the Yorkshire or Derbyshire Pits, delivered by Rail to Uxbridge Station, Great Western Railway. The above quantity of 5050 Tons may also be tendered for, part from the Durham and part from the Yorkshire or Derbyshire Pits, delivery as specified in each case.
Tenders are to state the Names of the Pits from which the above description of Coal will be supplied; the same to be fresh wrought and free from Slate and other Impurities, and to the entire satisfaction of the Company's Engineer.
Deliveries to be according to the requirements of the Company.
Tenders to be received on or before the 24th day of April next, addressed to the Chairman, Gas Company's Office, Uxbridge, Middlesex, and endorsed "Tender for Coal."
A Form of Tender will be sent on application.
W. M. GARDINER,
Secretary
Uxbridge, Middlesex,
April 11, 1900.

## TENDERS FOR COAL.

**THE Directors of the Dorking Gas Company** invite TENDERS for the supply of about 2000 Tons of unscreened DURHAM COAL, to be delivered in Trucks at Dorking Station, S.E.R., before Jan. 1, 1901.

Tenders, stating description of Coal, to be sent by post endorsed and addressed to the undersigned, not later than the 23rd inst.

S. CARPENTER,
Engineer and Manager.

## BOROUGH OF LEIGH.
(GAS DEPARTMENT.)

**THE Gas Committee of the above Corporation** invite TENDERS for the supply of SULPHURIC ACID during the Twelve Months ending June 30, 1901.

Forms of Tender and further Particulars may be obtained from the Manager, Mr. John Foster, Gas-Works, Leigh.

Sealed Tenders, endorsed "Tender for Sulphuric Acid," to be delivered to me on or before Twelve o'clock noon, on Saturday, April 21, 1900.

By order,
PEREGRINE THOMAS,
Town Clerk.

Town Hall, Leigh, Lancs.,
April 3, 1900.

## BOROUGH OF LEIGH.
(GAS DEPARTMENT.)

**THE Gas Committee of the above Corporation** invite TENDERS for the supply of 12,000 Tons of GAS COAL and 2000 Tons of CANNEL, during the Twelve Months ending June 30, 1901.

Forms of Tender and further Particulars may be obtained from the Manager, Mr. John Foster, Gas-Works, Leigh.

Sealed Tenders, endorsed "Tender for Coal or Cannel," as the case may be, to be delivered to the undersigned not later than Twelve o'clock noon, on Saturday, April 21, 1900.

By order,
PEREGRINE THOMAS,
Town Clerk.

Town Hall, Leigh, Lancs.,
April 3, 1900.

## MARKET HARBOROUGH URBAN DISTRICT COUNCIL.

TENDERS FOR GAS COAL.

**THE Gas Committee of the above are** prepared to receive TENDERS for the supply of the whole or part of from 3500 to 4000 Tons of Best Screened GAS COALS or NUTS, to be delivered as may be required during the Year ending May 31, 1901, at the Sidings of the London and North-Western Railway or Midland Railway Station, Market Harborough.

Forms of Tender, and any further Information, may be had on application to the undersigned, to whom sealed Tenders, endorsed "Tender for Coal," must be delivered on or before the 24th inst.

The lowest or any Tender not necessarily accepted.

A. T. HARRIS,
Engineer and Manager.

Gas Offices: St. Mary's Road,
Market Harborough, April 3, 1900.

## BOROUGH OF SMETHWICK GAS-WORKS.

TENDERS FOR NEW PURIFIERS.

**THE Gas Committee invite Tenders—**

1. For Building a BRICK PIT, 88 ft. 6 in. by 62 ft. 2 in. and the PIERS to carry four Purifiers.
2. For a Set of four PURIFIERS, 36 ft. by 24 ft., and Covers, with Valves, Connecting Mains, and Lifting Gear.

Copies of Specifications and Drawings may be obtained on application to Mr. B. W. Smith, at the Gas-Works, at a charge of £1 1s., which will be returned upon receipt of a *bonâ-fide* Tender.

Contractors will be required to pay the Standard Rate of Wages recognized in the District.

Tenders, endorsed "Contract No. 1" or "Contract No. 2," and addressed to the Chairman of the Gas Committee, to be delivered to the undersigned on or before the 3rd of May next.

The Committee do not bind themselves to accept the lowest or any Tender.

By order,
(Signed) W. J. STURGES,
Secretary.

Gas Offices, Town Hall,
Smethwick, April 9, 1900.

## BOROUGH OF PLYMOUTH.

**THE Plymouth Corporation are prepared** to receive TENDERS for the under-mentioned Articles, in connection with the Street Lighting of the Borough, viz:—

CONTRACT No. 1.—LANTERNS, FROGS, &c.
CONTRACT No. 2.—INCANDESCENT BURNERS, MANTLES, GOVERNORS, STOPCOCKS, &c.

Contractors may not Tender for a part of any Contract.

Copies of the Conditions, Specifications, and Forms of Tender, bound up together, may be had from the undersigned on the deposit of One Guinea for each copy, which will be returned upon the receipt of a *bonâ-fide* Tender upon the prescribed form, and within the stated time.

It is a condition of tendering that samples of the various Articles required shall accompany the Tender.

Should a Contractor withdraw his Tender, the amount of his deposit will be forfeited.

Sealed Tenders, endorsed, "Contract No. ....," must be delivered to the undersigned not later than the 3rd day of May, 1900.

The Corporation do not bind themselves to accept the lowest or any Tender.

JOHN H. RIDER,
Borough Electrical Engineer.

Prince Rock, Plymouth,
April 6, 1900.

**THE Directors of the Kildwick Parish** Gas Company invite TENDERS for the supply of the whole or part of 4500 Tons of GAS COAL or NUTS, to be delivered free in the Company's Siding at Kildwick, during the Twelve Months ending June 30, 1901.

Tenders to be sent in not later than April 28, 1900, to

FRED. H. PICKLES,
Manager and Secretary.

Gas-Works, Kildwick,
April 11, 1900.

## HAWORTH URBAN DISTRICT COUNCIL.

**THE above Council are prepared to re**ceive TENDERS for the supply of 3000 Tons of GAS COAL (screened or unscreened), delivered at the Station of the Midland Railway Company, Haworth, during the ensuing Twelve Months.

Tenders to be sent to me the undersigned not later than Thursday, the 26th inst.

WM. ROBERTSHAW,
Clerk.

Burlington Chambers, North Street,
Keighley.

## BOROUGH OF CLITHEROE.
(GAS DEPARTMENT.)

TENDERS FOR GAS COAL.

**THE Gas Committee invite Tenders for** the supply of 4000 Tons of screened GAS COAL, to be delivered during the Year ending May 31, 1901.

Further Particulars and Form of Tender may be obtained from the undersigned.

Sealed Tenders, endorsed "Tender for Gas Coal," addressed to the Chairman of the Gas Committee, to be delivered at my Office on or before Tuesday, the 1st of May, 1900.

ROBT. BARRETT.

Gas-Works, Clitheroe,
April 11, 1900.

## ULVERSTON URBAN DISTRICT COUNCIL.

TO TAR DISTILLERS.

**THE Gas and Water Committee invite** TENDERS for the purchase of the surplus TAR produced at their Works, during the Year commencing the 1st of July next.

Further Information and Forms of Tender may be had on application to the undersigned.

Sealed Tenders to be sent in not later than Thursday, the 26th inst., addressed to the Chairman of the Gas and Water Committee, endorsed "Tender for Tar."

The Committee do not bind themselves to accept the highest or any Tender.

JNO. SWAN,
Engineer and Manager.

## CANTERBURY GAS AND WATER COMPANY.

TENDERS FOR GAS COALS.

**TENDERS are invited for the supply of** 14,000 Tons of the best GAS COALS, to be delivered during One Year, commencing on the 1st of June next.

Forms of Tender, containing Particulars and Conditions of the Contract, may be obtained on application to the undersigned.

Sealed Tenders, endorsed "Coals," to be delivered at the Company's Offices, Castle Street, Canterbury, on or before Saturday, the 12th of May next.

By order,
JAMES BURCH,
Secretary.

April 9, 1900.

## CORPORATION OF LEICESTER.

GAS COAL.

**THE Gas and Electric Lighting Com**mittee of the above Corporation are prepared to receive TENDERS for the supply of COAL, COBBLES, or NUTS, about 180,000 Tons, for the Twelve Months ending May 31, 1901.

Particulars and Form of Tender can be obtained on application to the Engineer.

Tenders, addressed to Alderman Lennard, J.P., Chairman, and endorsed "Tender for Gas Coal," to be delivered at these Offices not later than Eleven o'clock a.m., on Tuesday, April 24, 1900.

The Committee do not bind themselves to accept the lowest or any Tender.

ALFRED COLSON, M.Inst.C.E.,
Engineer and Manager.

Offices: Millstone Lane,
Leicester, April 10, 1900.

## BRISTOL WATER-WORKS COMPANY.

SALE OF ORDINARY STOCK.

**MESSRS. ALEXANDER, DANIEL, &** Co. will SELL by AUCTION, at the Bank Auction Mart, Corn Street, Bristol, on Thursday, the 26th of April, 1900, at Two o'clock in the Afternoon,

£15,000

BRISTOL WATER-WORKS 7 PER CENT. MAXIMUM CONSOLIDATED ORDINARY STOCK, in Lots of £100, at the Reserved Price of £158 for every £100 Stock.

The above £15,000 Stock is part of the 7 per cent. Maximum Consolidated Ordinary Stock, amounting to £690,000, created under the powers of the Bristol Water-Works Acts, 1888, 1889, and 1895.

The Dividend is subject to proportionate diminution whenever the Maximum Dividend to which each class of Ordinary Shares or Ordinary Stock of the Company is entitled shall not be paid in full, but such diminution may be made up in subsequent Years.

For further Particulars and Conditions of Sale, apply to the AUCTIONEERS, Bank Chambers, Corn Street, BRISTOL (and 3, Gracechurch Street, LONDON, E.C.); to FUSSELL AND CO., Solicitors, 36, Corn Street, BRISTOL; or to

ALFRED J. ALEXANDER,
Secretary and General Manager.

Bristol Water-Works Office,
Small Street, Bristol.

## GEORGETOWN (BRITISH GUIANA) GAS COMPANY, LIMITED.

**NOTICE is Hereby Given, that the** ORDINARY HALF-YEARLY GENERAL MEETING of the Shareholders of the above Company, will be held at the Offices of the Company, 30, Gracechurch Street, in the City of London, on Tuesday, the 1st day of May next, at Three o'clock in the afternoon precisely, to receive the Directors' Report and the Accounts of the Company for the Half Year ended the 31st day of December last, to elect Directors and an Auditor in place of those retiring by rotation, and to transact the General Business of the Company.

The TRANSFER BOOKS WILL BE CLOSED from the 18th inst. to the 1st prox., both inclusive.

By order of the Board,
SAMUEL WOOD,
Secretary.

Offices: 30, Gracechurch Street,
London, April 11, 1900.

## SALES BY AUCTION OF GAS AND WATER STOCKS AND SHARES.

**MR. ALFRED RICHARDS begs to** notify that his AUCTIONS of STOCKS and SHARES in London, Suburban, and Provincial Gas and Water Companies are held PERIODICALLY, at the Mart, Tokenhouse Yard, E.C.

He also undertakes the issuing by AUCTION of GAS and WATER STOCKS and SHARES under Parliamentary Powers.

Terms for issuing such Capital, and also for including Gas and Water Stocks and Shares in these periodical Sales, can be obtained on application at Mr. ALFRED RICHARDS' OFFICES, 18, FINSBURY CIRCUS, E.C.

By order of the Directors of the
**LEA BRIDGE DISTRICT GAS COMPANY.**

NEW ISSUE OF
£10,000 CONSOLIDATED ORDINARY STOCK.

**MR. ALFRED RICHARDS will Sell** THE ABOVE BY AUCTION, at the Mart, E.C., on Tuesday, the 24th of April, at Two o'clock, in Lots.

Particulars of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

By order of the Directors of the
**WEST HAM GAS COMPANY.**

NEW ISSUE OF 2500 £10 ORDINARY SHARES.

**MR. ALFRED RICHARDS will Sell** THE ABOVE BY AUCTION, at the Mart, E.C., on Wednesday, May 2, at Two o'clock, in Lots.

Particulars of the SECRETARY of the Company, at the Offices, Union Street, STRATFORD; and of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

By order of the Directors of the
**ILFORD GAS COMPANY.**

£10,000 ORDINARY STOCK.

**MR. ALFRED RICHARDS will Sell** THE ABOVE BY AUCTION, at the Mart, E.C., on Tuesday, May 8, at Two o'clock, in Lots.

Particulars of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

By order of the Directors of the
**SOUTHEND WATER-WORKS COMPANY.**

NEW ISSUE OF 1000 £10 NEW ORDINARY SHARES, & 15 £10 ADDITIONAL ORDINARY SHARES.

**MR. ALFRED RICHARDS will Sell** THE ABOVE BY AUCTION, at the Mart, E.C., on Tuesday, May 8, at Two o'clock.

Particulars of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

## SAWSTON GAS-WORKS, CAMBRIDGESHIRE.

Almost equi-distant from Whittlesford and Shelford Stations on the Main Cambridge Line of the Great Eastern Railway. The Works are conveniently situate, and comprise Retort-House (with six Retorts), Coal-Shed, Purifier-House, Gasholder, Meter-House, Governor-House, Workshop, Large Yard, and Manager's House, together with the Mains; the whole to be sold as a going concern, and with possession on completion. Held for a term of about 70 years unexpired, at a nominal Rent of £1 per annum.

**MR. ALFRED RICHARDS will Sell** THE ABOVE BY AUCTION, at the Mart, Tokenhouse Yard, E.C., on Tuesday, May 8, at Two o'clock precisely.

Particulars of Mr. ALFRED RICHARDS, Auctioneer, 18, FINSBURY CIRCUS, E.C.

*Price 6s., Cloth Bound,*

**THE CHEMISTRY OF ILLUMINATING GAS.**

By N. H. HUMPHRYS, Assoc.M.Inst.C.E., F.C.S.

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**16, DEANSGATE, MANCHESTER.**
**GAS ENGINEERS' AGENTS AND CONTRACTORS FOR**
**Meters, Fire-Clay Goods, Oxide of Iron, and all other Gas Apparatus. Retort Carbon purchased.**
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*Night or Day.*

HOT BATH WHEN WANTED.

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**Present Daily Produce over 5000 Tons.**

*Latest Analysis—By CHARLES PHILLIPS, Gas Examiner to Rotherham Corporation*

Yield of Gas per Ton . . . 11,205 Cubic Feet.
Illuminating Power $16\frac{7}{10}$ Stand. Sperm. Candl.
Coke (of good & pure quality) $18\frac{3}{4}$ Cwt. per Ton.
Sulphur . . . . . A little over 1 per Cent.
Ash . . . . . Under 1 per Cent.
Tar . . . . . 163 lbs. (Avoir.) per Ton.
Ammoniacal Liquor 103 lbs. (Avoir.) per Ton.

HOLMSIDE GAS COALS are supplied to the largest Gas Companies in England and on the European Continent; London alone consuming about half the produce.

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Both descriptions are shipped at Tyne Docks, and Dunston Staiths, River Tyne, also at North and South Docks, Sunderland.

These Coals may be bought through the Principal Merchants in England, or direct from

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## NEWBATTLE CANNEL.

Highest Results in Gas, & Excellent Coke.

QUOTATIONS ON APPLICATION TO

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LIMITED,

NEWBATTLE COLLIERIES,

DALKEITH N.B.

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Gas Companies are solicited to try Samples of the

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*Prices and Analysis on application.*

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RAVENSTHORPE, NEAR DEWSBURY.

## BOLDON GAS COALS.

ANALYSIS.

| | | |
|---|---|---|
| Yield of Gas per Ton. . | 10,500 | Cubic Feet. |
| Illuminating Power . . | 16·9 | Candles. |
| Coke . . . . . | 66·7 | Coke. |
| Sulphur . . . . . | 0·86 | Sulphur. |
| Ash . . . . . | 2·04 | Ash. |

For Prices, &c., apply to

W. H. PARKINSON,

THE HARTON COAL CO., LTD.,

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Telegraphic Address: "PARKINSON, NEWCASTLE."

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WORKED BY THE

WEARDALE IRON & COAL Co., Ld.

OUT OF THEIR

THORNLEY AND WHEATLEY HILL COLLIERIES.

Analysis made by

Messrs. J. & H. S. PATTINSON.

| | | |
|---|---|---|
| Yield of Gas per Ton . . | 10,500 | Cub. Ft. |
| Illuminating Power . . . | 16·9 | Candles. |
| Coke (of good quality) . . | 67·5 | per Cent. |
| Sulphur . . . . . | 0·58 | ,, |
| Ash . . . . . | 2·73 | ,, |

For Price, &c., apply to the

WEARDALE IRON & COAL Co., Ld.

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## LONDONDERRY GAS COALS

FROM THE

LONDONDERRY COLLIERIES,

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Available Output up to 5000 Tons per day.
Yield of Gas 11,000 cubic feet per Ton of Coal as per Analysis by
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FOR PRICES AND PARTICULARS, APPLY TO

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Awarded HIGHEST MEDAL and DIPLOMA at the Newcastle-on-Tyne Royal Mining and Industrial Exhibition, 1887, for

## CANNEL & COAL.

TYNE

## BOGHEAD CANNEL.

| | |
|---|---|
| Yield of Gas per ton . . . . | 13,155 cub. ft. |
| Illuminating Power . . . . | 38·22 candles. |
| Coke per ton . . . . . | 1,301·88 lbs. |

## EAST PONTOP GAS COAL.

| | |
|---|---|
| Yield of Gas per ton . . . . | 10,500 cub. ft. |
| Illuminating Power . . . . | 17·8 candles. |
| Coke . . . . . | 70 per cent. |

## SOUTH PELAW MAIN GAS COAL.

| | |
|---|---|
| Yield of Gas per ton . . . . | 10,500 cub. ft. |
| Illuminating Power . . . . | 16·3 candles. |
| Coke . . . . . | 73·1 per cent. |

*For Prices and complete Analysis, apply to*

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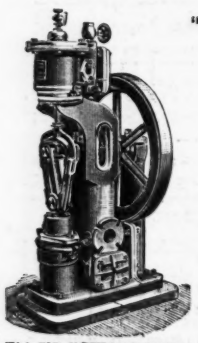

Fig. 705. "SINGLE RAM" STEAM-PUMP.

Fig. 893. "CORNISH" STEAM-PUMP FOR BOILER FEEDING, &c.

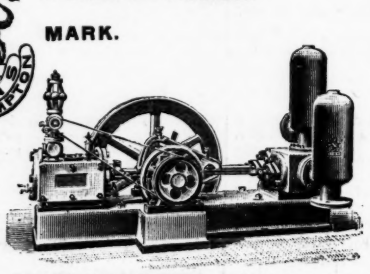

Fig. 685. "RELIABLE" STEAM-PUMP FOR TAR AND THICK FLUIDS.

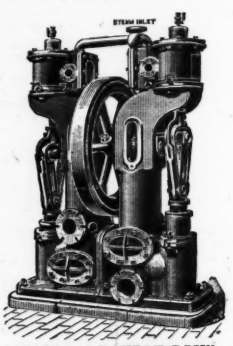

Fig. 712. "DOUBLE-RAM" STEAM-PUMP.

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*Specialities*:

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Rope and Belt Pulleys,
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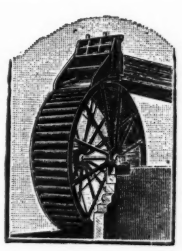

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*AND*

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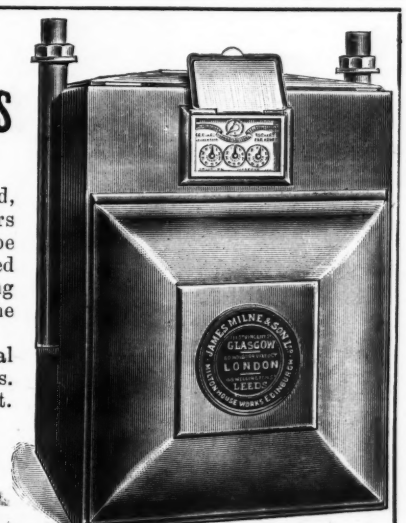
## WET & DRY GAS-METERS

These Wet Meters are still preferred, in many cases, to Compensating Meters on account of the long time they can be left without re-watering; the improved construction and shape allowing a long range of water-line without affecting the registration.

Dry Meters of Special Charcoal Tinned Iron, with many Improvements. Extra Thick Tin Plate used throughout.

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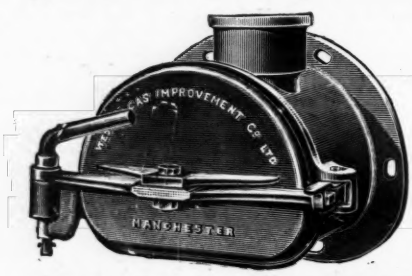


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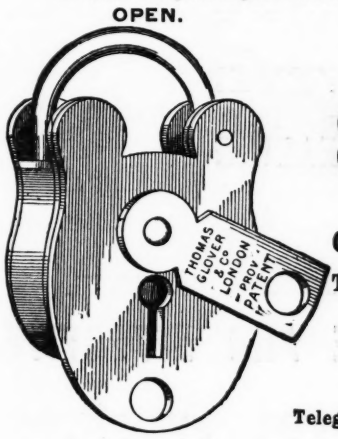


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PREVENTS TAMPERING WITH THE

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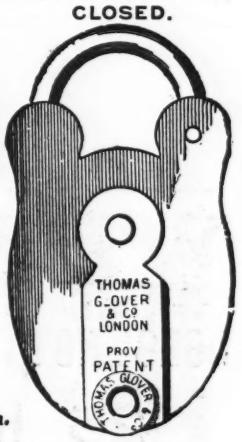


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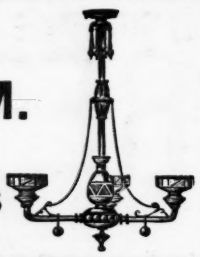

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[See Illustrated Advertisement, April 3, p. 848.]

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**LUMPS, TILES, AND ALL ARTICLES IN FIRE-CLAY.**
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**Manufacturers of Glasshouse Pots and Crucibles of every kind.**
**Established 1836.**

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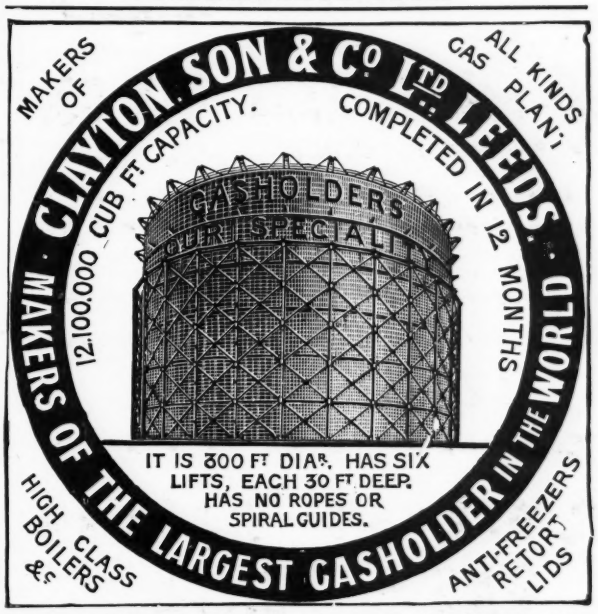
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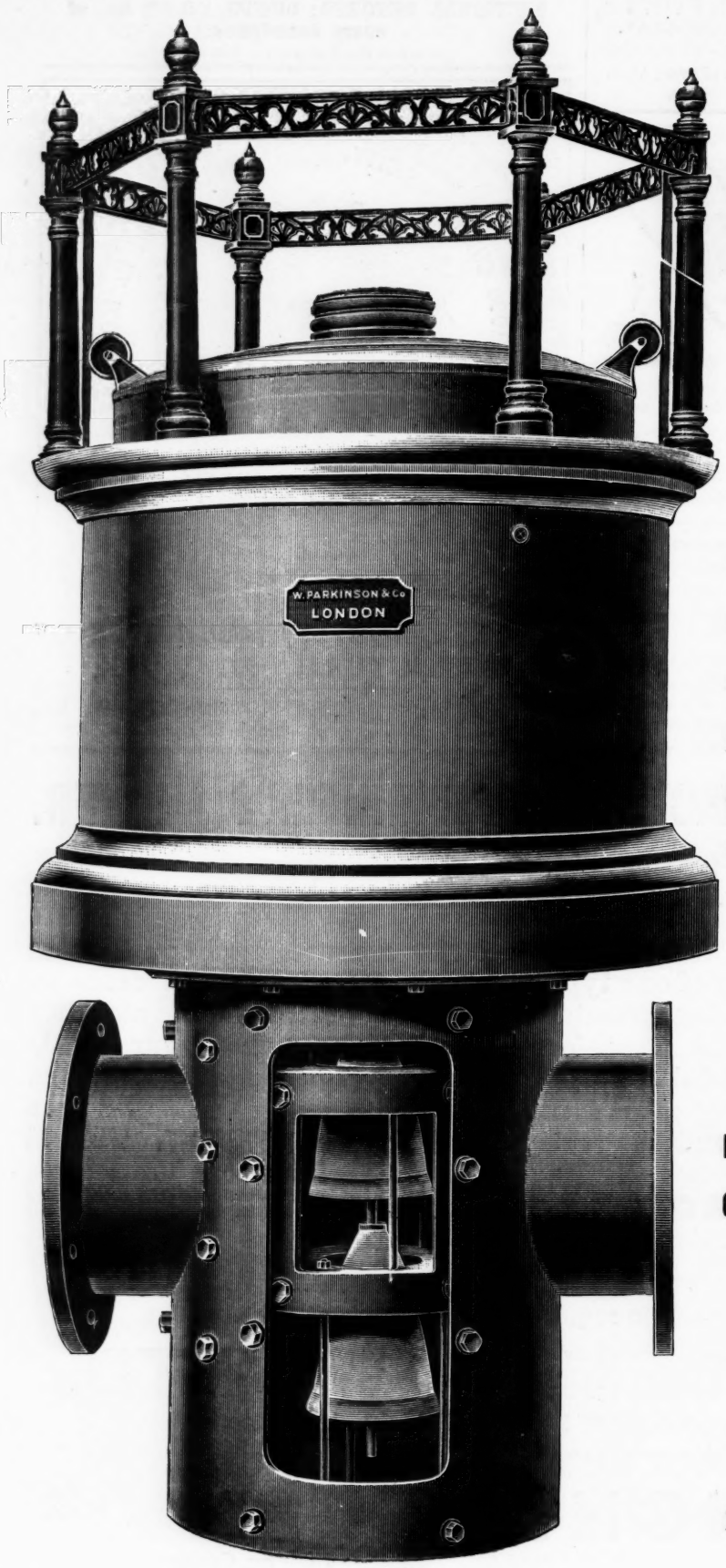


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[See also Advt., p. 986.

LONDON: Printed by WALTER KING (at the Office of King, Sell, and Railton, Ltd., 12, Gough Square); and published by him at 11, Bolt Court, Fleet Street, in the City of London,—Tuesday, April 17, 1900.